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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

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Engineers Again Honor Hoover

IT IS fitting that the engineers of New York City, on Mr. Hoover's return from abroad next week, should be among the first to receive him. Under the auspices of his own society, the American Institute of Mining and Metallurgical Engineers, his professional brethren will honor him at a dinner Sept. 17. However elaborate the affair, it cannot do adequate honor to the most outstanding engineer in the Great War. In fact, he compares not with engineers merely in this conflict, but with all the real leaders, whether statesmen like Lloyd George, or soldiers like Foch and Haig and Pershing or moral leaders like Cardinal Mercier. Before we entered the war he carried out a task of unheard-of delicacy—the provisioning of a conquered territory under a meticulous and merciless conqueror. On our entry into the war, he assumed a work of even greater proportions—the provisioning of the allies through the self-denial of the American people. Both tasks he carried out with singular success. Europe has gone to its utmost in expressing its appreciation and gratitude. Engineers and the public in America, through a variety of honors, have already given expression to their feelings toward him, but now that he returns, the major part of his great tasks completed, it is fitting that engineers should be among the first to welcome him.

Wind Pressures at Great Heights

SO FAR as wind effects at ordinary levels are concerned, the sane and well-judged review of the subject on p. 499 is a valuable summary of good practice in the design of engineering structures. Present-day methods produce safe structures, as witnessed by the fact that failures due to wind are almost unheard-of; but there is room for improvement in economy and also for fuller recognition of regional differences in maximum velocities, such as the difference between the Gulf coast and inland points mentioned in the text. The article should prove helpful, also, because in conjunction with companion articles yet to be published it clears up some points of difficulty in the practical application of wind calculations. It suggests a thought, however, which may have distinct future importance, though it lies outside the range of present practice in dealing with wind pressures. What we know about wind relates to a very narrow zone of height, two or three hundred feet above ground, perhaps; above this zone our data apply only by extension. Today many engineering structures rise far above the zone of established wind-pressure data, and heights are likely to increase further in the future. We have reason, then, to give heed to the possibility that greater wind velocities occur far above ground than in the lower zone. A worthwhile field for experimental study lies in this possibility.

The President's Industrial Conference

WHAT good may come from the conference which the President has called to discuss with all parties at issue the present industrial crisis, and particularly the problems between employer and employee? If it is to be a conference and nothing else, it may help in lending an added dignity to things we already know—nothing else. If it has leadership, if the President uses the presidential influence to initiate a program, something worthwhile may come of it. By the time of the conference, too, the President should have in hand pertinent data on the extent and means of profiteering in certain lines of business. The Department of Justice has various investigations in hand, regarding prices of leather, foodstuffs, etc., and if there be obtained indisputable evidence of profiteering the President will be in a position to hold up the wrongdoing of the employing interests to the country and to get the backing of the people for drastic measures that he, with the aid of Congress, may decide to adopt. On the other hand, he will have there the leaders of labor, and them he must bring to agreement regarding a propaganda in sound principles of production. This is no one-sided affair. Neither can the operator of industry profiteer by unfair high prices, nor can the employee profiteer by giving less than an honest day's work for his pay. The President has a great opportunity in the coming conference. He has shown in the past month appreciation of the fundamentals of the problem. Can he make action square with his theoretical conception of the issues?

Little Danger in Rich Concrete

THAT rich concrete cracks more readily than lean is probably the off-hand opinion of the majority of engineers. The explanation is not hard to find. Tests have shown an increasing expansion, due to temperature and moisture, with an increasing proportion of cement in a mortar. Observation is common that the rich cement-mortar finish of the concrete of a decade or so ago soon shows a multitude of map cracks and later more serious disintegration. On the basis of both tests and observation, the general deduction as to concrete work has been easy. In spite of this, the fact is, as pointed out by several engineers in the symposium on another page, that the application of the principle to commercial concrete work is not justified by any serious laboratory or service tests. Rich mortars do not necessarily act the same way as a commercial concrete, and the map cracking of the thin mortar coat is due to differential expansion. Within the limits of mixtures used in structures there is no reason to believe that cracking, either of the surface or of the body, is to be expected on account of the variation in the cement mixture, except as that variation affects the

actual strength of the concrete. Indeed, the richest concrete consistently used in any number of structures—the 1:2/3:4/3 mix of the recent Government concrete ships—is singularly free from cracking. In concrete road foundations and surfaces, where the subject today is especially pertinent, there does not seem to be any need for alarm, from the standpoint of cracking due to internal movement, in the use of mixtures even richer than the richest commonly used.

Highways and Shade Trees

ELOQUENT advocacy of reforestation by the planting of shade trees along the highways has recently appeared in the daily press. The French roads have been cited as examples of such use of the roadside, and the recommendations have extended even to obtaining revenue for the upkeep of the roads by selling the fruit which might be grown if apple, peach or cherry trees were planted. While the æsthetic features of highway shading are apparent to every one, it should not be forgotten that in many sections of the country soil conditions are such that shade trees are a positive detriment to the roads. The trees keep the heavier soil, such as clay, from drying out, and a decided tendency to disintegration is noted where shade is abundant, particularly in macadam roads. On wide thoroughfares, where the trees would be some distance from the pavement, they would be less detrimental, but on the narrow country highways, where shading has the most charm, and where the roads are largely of the lighter types of construction, such as water-bound and bituminous macadam, it seems doubtful whether the trees should be planted. On soil which may be thoroughly underdrained shade has little detrimental effect, unless the surfacing is made of ingredients that are directly affected by moisture. Its effect on the retention of water by heavy-soil subgrades, eliminating proper support of the base, and causing freezing and heaving of the pavement in winter, is worthy of careful attention. Tree planting certainly should not be inaugurated indiscriminately.

Timber Supply and Forest Protection

FOREST conservation or rigid restriction of timber exports are the alternative policies to provide against exhaustion of our timber resources. The first of these is the more logical policy. This summarizes the arguments presented by Henry S. Graves, of the United States Forest Service, in a pamphlet on "Lumber Export and Our Forests," issued by the United States Department of Agriculture. Other countries are regulating the cutting of timber and are developing forest plantations as a means of conserving their present supplies and providing a future permanent supply to meet conditions following the enormous use and destruction of timber during the war.

Reconstruction work will demand great quantities of timber, but to export this material without some policy of replacement would be ruinous. According to Mr. Graves, this is recognized by practically all the timber-exporting countries except the United States. He states that in this country there is no governing influence on the handling of forests in private ownership, and they are "mined" instead of being treated as a renewable resource. He says further: "There is no effort to secure replacement after cutting. In many parts there is not even any serious effort to keep out forest fires that consume the young growth and prevent reproduction. The owners are not interested in and do not assume the responsibility for replacing the forests, even by natural reproduction. Industries dependent upon wood are already going out of business. Local exhaustion of the forests is leaving great stretches of land in an unproductive condition."

This is a serious indictment, but it is supported by the history of the reckless use, abuse and destruction of our vast timber resources. The remedy, in Mr. Graves' opinion, is not the arbitrary restriction of timber exports but rather a national policy of forest protection and the use of such methods of cutting as will provide for reproduction. At one time, the idea of conservation was simply to forbid the cutting of timber, but more enlightened ideas regard the forests as crops capable of producing a permanent supply of timber sufficient for our own use and for export. It is high time that some definite action should be taken along these lines, but it will need an energetic and persistent campaign of education to bring it about.

What Will Engineers Pay To Improve Their Status?

ENGINEERING COUNCIL'S difficulty in obtaining funds for its Washington office prompts the query, How much is the individual engineer willing to pay to have his societies engage in civic and welfare work?

The question is all the more pertinent because Engineering Council once sounded members of the profession, but without encouraging response, on the proposal of contributions to Engineering Council of $1 per member. Are we to conclude that engineers will not pay $1 a year to have their status improved, or is the declination of funds to be assigned to other motives?

Engineering News-Record has no doubt as to the attitude of the profession; engineers *will* pay not merely $1 a year for civic and welfare work, but $3 and even $5. But they will not join a society or support a movement unless the objects are broad, the plans detailed and the execution guaranteed by real leaders, by men of action. Given these things, membership in an all-embracing federation of engineers would be forthcoming in large number, even though the dues be $3 or $5, instead of the $1 so generally proposed.

If this view be correct, why, then, the present financial difficulties of Engineering Council? The reason is that a dramatic presentation of its case has not been made persistently to the individual members of the profession. Had the members of the founder societies been enthused with the council's plans, their executive bodies, forced by that enthusiasm, would have taken steps to secure the needed funds. The treasuries of the founder societies have been strained, but an appeal to the membership for separate support would not have gone unheeded, had the council made a strong impression.

We feel certain that the refusal of the members of the American Society of Civil Engineers to vote the $5 assessment for the Washington office of the council as proposed by motion at the annual meeting last January was due to lack of a detailed plan and strong presentation.

But these are mere opinions, even though founded on

close contact with the profession. Is there not evidence of what engineers will pay for civic and welfare service? We think there is—and in abundance.

Approximately 40,000 engineers are paying an average of $15 a year for membership in the founder societies. Is it conceivable that with a virile program these men would not pay $3 additional for civic and welfare work? They get prestige, acquaintanceship, information, from their technical society membership, and deem this personal return worth $15 a year. Would not the result of a $3 annual investment in civic and welfare work, so well done that it would improve the status of the engineer, add to the individual's pocketbook many times that amount—a hundredfold or more?

But there is other evidence. Approximately 4000 men have joined the American Association of Engineers in the past five years and pay $10 a year for *civic and welfare work alone*. And they, on the whole, are from the ranks less able to contribute to society support. The growth in membership is evidence of a result-producing propaganda, kept up with admirable persistence.

Now come the architects of New York State with an organization into which the draftsmen as well as the leading architects are invited, with annual dues of $5 for the registered architects and $3 for the draftsmen. In other words, the architects believe that even their beginners are ready to pay $3 a year for the improvement of the professional status.

With these examples in mind, can we doubt whether engineers will pay $1 a year? Can we doubt that a strong program would succeed in building up a large membership at $3 or even at $5 per annum?

The signs have, for a year or more, pointed to a change in the basis of membership in Engineering Council. The report of the conference committee should deal with it. In any plan the problem of funds will come in for consideration. To our mind the problem is not a serious one so long as the plan is big and strong and is based on a correct conception of what the profession wants. That being furnished, the building up of membership depends on persistent education.

The need for persistent promotion must be clearly recognized. One neglects the inertia of human nature if he assumes that a good plan will be embraced by one announcement of it. Life insurance, a most beneficent institution, is taken by most men only after persistent efforts of salesmen. In this work, society promotion, we have much to learn from the A. A. E.

Essentials of the Railroad Problem

ONE is tempted, as new plans for the solution of our railroad problem are brought forward, to dismiss them in turn with a confused feeling that just another plan has come to becloud the atmosphere. Yet a multitude of plans is not to be deplored. Even though offered to bolster up a special interest, as many of them are, they help to sort out those elements on which there is agreement and to define the issues that are debatable.

Without reference to anything that may have been proposed, one can easily lay down certain essentials of the ultimate plan. It must (1) end corporate profiteering; (2) give the worker a more direct interest in the industry; (3) provide incentives for efficient management.

The first two requirements are beyond debate. The public has determined that they must be adopted; of that there is not room for reasonable doubt. There has been less general consideration of the third essential, but no thoughtful man would provide a settlement that did not encourage efficiency on the part of both worker and management.

The wide acceptance of these ideas is evidenced by their inclusion—in part, at least—in most of the plans presented. In some, provision for the workers is limited to profit-sharing; in others, directorate representation, a more important step, is included.

When we get beyond these three *sine qua non* provisions we are on debatable ground, the argument waging fiercest around the issue of Government vs. private ownership. To our mind, the ownership issue is really secondary; it rests on grounds of expediency. The question of Government vs. private *operation* is far more important. It is in operation that profits are made or losses incurred; it is operation that determines, largely, the amount of property (i.e., capital investment) required and the efficiency of its use and maintenance. The prejudice against public ownership, when analyzed, is found to be due to dissatisfaction with public *operation* rather than *ownership*. That which we must adhere to, and which becomes the *fourth essential* is *private operation*. Even the Plumb plan accepts this principle; it provides for lease of the roads to an operating corporation, in which the public (and hence the Government) would have minority representation (one-third of the directorate).

The issue of public vs. private *ownership* enters most largely, in our mind, in its relation to operation. If private operation could persist, unhampered in efficiency, under public ownership, we should have little quarrel with it. Under Government ownership, however, private operation would probably suffer much interference. Private ownership, it is true, would not insure the operators against hampering meddling, but the amount of it would probably be less than if the public owned the properties. Certainly, as a first step some scheme of private ownership under broad control should be tried. If the drift toward nationalization should continue, if, under a revised plan of private ownership, we should not achieve the ends we have in view in the present railroad reorganization, we should, at least, learn much to guide us in drafting the subsequent plan.

The details of the final scheme must flow, in large part, from the essentials above laid down. Here again the multiplicity of plans has helped to narrow the discussion. There must be Government control of financing, there must be limitation of return on the investment, there must be an efficiency incentive for both management and employee, there must be Government representation in the directorate. Efficiency, too, urges that there be competitive systems, rather than a single operating unit. On the other hand, there should be common use of terminals and other facilities that will conduce to efficiency of operation and to better service to the public.

Obviously, there are many ways in which these purposes may be accomplished. The details are important, but if the essentials be not included the results will be so far from satisfactory that the job will soon need re-doing. No profiteering, incentives to efficiency for management and employee, private operation—these, at least, are essentials of any satisfactory plan.

Rapid Concreting a Feature of Big Portsmouth Dry Dock

Installation of Duplicate Mixer Units of Large Size Makes Possible the Placing of 16,600 Cubic Yards in One Month—Total Concrete Yardage Was 185,000

EXCAVATING equipment which did not interfere with the early start and rapid progress of concreting, an organization capable of preparing forms, concreting equipment capable of placing a thousand yards a day, and favorable foundation conditions, were important factors in the construction at Portsmouth, Va., of the 1000-ft. Navy Yard dry dock.

The foundation conditions at the site were almost ideal. After penetrating an 18-ft. fill of rubbish and beach sand, 40 ft. of heavy blue clay was encountered. The bottom of the dock was in hard marl, fully capable of carrying the weight of the structure without piles, and almost water-tight. The pumping amounted to only 150 to 300 gal. per minute, and was taken care of with 6-in. motor-driven centrifugal pumps.

At least six months' time was saved in the completion of the contract by the use of 5-yd. dragline ex-

THE BULK OF THE EXCAVATION WAS DONE WITH FIVE-YARD DRAGLINES WORKING FROM THE SURFACE

cavators for digging out the site of the dock. This equipment was selected because with it work could be carried on from the surface of the ground, without blocking form construction and concrete work with tracks leading down into the hole. On account of the depth of the excavation the latter procedure would have been difficult and slow in any case. It was avoided on the last lift by using an inclined railway to elevate part of the spoil to the tracks above, as shown in one of the views. Cableways might have been employed, but their capacity would have been far below that of the two draglines used. The bank supported the weight of these machines without difficulty during the entire progress of the work.

Excavation was started at the river end of the dock in the latter part of February, 1917. On Aug. 20, six months later and six months before the 625,000 yd. of excavation had been completed, the first concrete was placed in one of the floor monoliths of the dock near the river end. The excavation was closed off from the river by a clay embankment, down the center of which was a line of 45-ft. steel sheet piling driven with steam hammers handled by derricks. Behind this bank, excavation was carried down to the bottom of the dock floor, and a sheeted pit 68 ft. wide by 233 ft. long was dug below this elevation for the gate sills. The excavation was then carried back toward the head of the dock, two lifts being taken out at first and three toward the last. The draglines dumped into 12-yd. air dump cars hauled in four- and six-car trains by 50- and 40-ton locomotives. These trains were discharged into scows for about half of the spoil, which was hauled to sea and dumped. The remainder was used for fill in the Navy Yard and for backfilling around the dock.

After concreting was started, Aug. 20, 1917, an average of 12,000 yd. per month was maintained until all of the concrete had been placed by Jan. 15 of this year. On Nov. 15, 1918, however, 181,000 yd. had been placed, leaving only 4000 yd. to be handled in small amounts. The best record was made in May, 1918, when 16,600 yd. of concrete was placed. This performance was almost equaled in October, 1917, when 15,330 yd. was put in; more than 14,000 yd. was placed in March, 1918. The best single day's run was made by one 2-yd. mixer which placed 1150 yd. of concrete in 22 consecutive hours on Dec. 20-21, 1917. After concrete work had been started it was continued except for an eight-day interruption during the extremely cold weather in the early part of 1918, when the thermometer at Norfolk reached 6 deg. above zero, Fahrenheit.

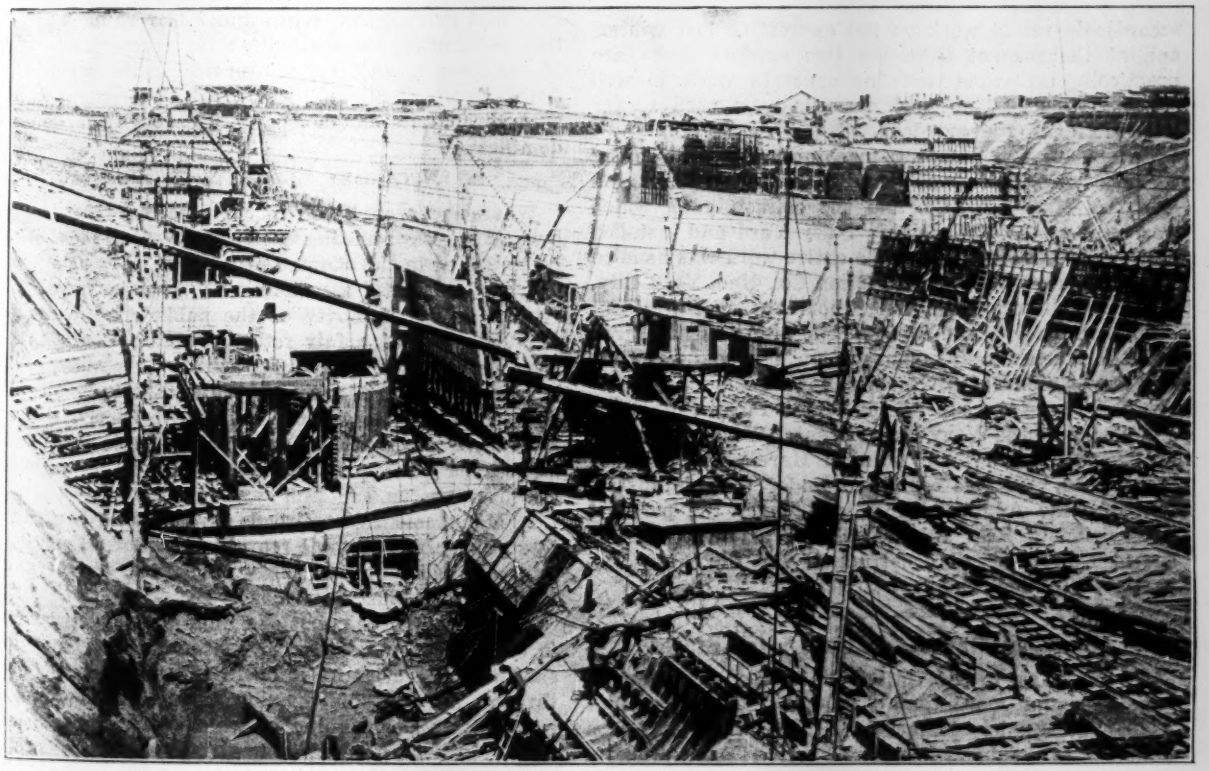
Although this rapid concreting was facilitated by the large size of the monoliths, the form work for the dock walls was complicated and required careful planning. The floor was placed in alternate sections to full depth, the width of the sections ranging from 9 to 14 ft., and the yardage from 750 to 1200 per block. The side walls were poured in lifts varying with conditions, but for the most part from 3 to 4 ft. in height. Practically all known types of form were used on the walls, it finally being the conclusion of those in charge of the work that wooden forms were more economical than steel, on account of the many offsets, tunnels and passageways required.

The design of the concrete plant which made this unusual performance possible was based on duplicate mixer units of large size, ample capacity for handling materials, and rail transportation to points at ground level, directly above the blocks being poured, from which concrete could be spouted to place. Cement was received in bulk in box cars at the dock, alongside which the sand and gravel lighters were unloaded. This work was done with three stiff-leg derricks, each handling a 1½-yd. clamshell. One of them unloaded into stock, for which space for 1400-yd. storage was available, while the other two reached the stock area and also discharged into two sets of bins, each of which held 80 yd. of sand and 160 yd. of gravel and which fed the pair of 2-yd. mixers by gravity. The mixers were placed just below the downstream corner of the dock and were connected by track with a belt line which circled the dock. The track was shifted from time to time and switches were put in or taken out as work progressed.

In addition to having two mixers ready to run, mak-

A TOTAL OF 185,000 YARDS OF CONCRETE WAS REQUIRED TO COMPLETE DRY DOCK

ing it certain that concreting could proceed at all times, a third mixer was purchased, so that when one of the large machines had to be overhauled it could be taken out and the work done at leisure without leaving the job dependent upon a single mixer. The mixers discharged into 2-yd. side-gate cars, of which 16 were purchased. It was at first intended to run them on their own wheels. However, side-gate cars of this size had not previously been used, and these turned out to be top-heavy and difficult to keep on the rails. The side-gate bodies were therefore removed from the running gears and set on standard flat-cars, two bodies to a car. All combinations up to the total number of cars in service on the longest hauls were used in



AFTER TRIAL OF MANY TYPES, WOODEN FORMS WERE SELECTED AS MOST ECONOMICAL BECAUSE OF MANY OFFSETS, TUNNELS AND PASSAGEWAYS REQUIRED

transportation, as many as five locomotives being employed. Three of these were small steam dinkies, and the other two were 6-ton gasoline locomotives. Until the dock walls reached about half height it was possible to chute all of the concrete from the track level. The side-gate cars were discharged into the chute lines, often as many as three chute lines being strung into the same monolith, so that three 2-yd. cars could be emptied simultaneously.

After the excavation was completed and the walls reached a height which precluded direct spouting, hoppers were set up over the forms being poured, and both line chute and drop chute were used to convey concrete from the hoppers into the forms. The side-gate bodies were lifted off the decks of the flat-cars one at a time by the dragline, swung out over the hoppers on the forms and emptied into them. This proved a very efficient arrangement, the concrete being dumped almost as fast as when the cars were discharging directly into the chute lines.

Labor Uncertain

Labor conditions on the work were bad on account of the war and also varied greatly, so that the size of crew necessary for different operations changed from time to time and no reliable conclusion can be drawn as to the number of men required for handling work in this way under stable conditions.

After the main dock was well along toward completion, it was decided to build adjacent to it on the downstream side two 600-ft. docks for the Shipping Board. As the concrete plant was on ground to be removed by dredging beyond the outer end of these docks and between them and the large dock, it was not necessary to disturb it before beginning excavation on the two smaller projects. One of the draglines was accordingly set to work on the excavation last winter, and at the present time the two smaller docks are practically excavated and the concrete work is well along in them. The same methods were used as for constructing the larger dock.

Except for the pumping machinery for unwatering the dry dock, which was installed by the Worthington Pump & Machinery Co. and the caisson gate, which was built at the Philadelphia Navy Yard and installed by the Norfolk Navy Yard, the entire work was handled by the George Leary Construction Co., New York City, under the direction of Paul Schomberg, vice-president of the company. The work at the site was in charge of H. L. Muchemore as manager, under whom was General Superintendent Taft. The contract has been carried out under the supervision of the Bureau of Yards and Docks of the Navy Department. Work was begun at the time when Rear Admiral Harris was chief of the bureau, and was completed under the administration of Rear Admiral Parks, and under the personal supervision of Rear Admiral Harris after he had assumed charge of all construction for the Navy Department in the Norfolk District.

Municipal Markets in the United States

Of 227 cities in the United States having estimated populations of more than 30,000 more than one-half (128) had municipal markets in 1918, according to a bulletin on the subject just issued by the Census Bureau. A large percentage of these are open markets, but some are housed in large, permanent buildings.

A Plan for Private Operation of Federalized Railways

Employees Would Have Voice in Management and Share Surplus With Operators and the Public—Roads To Be Operated in Regional Groups

By William J. Wilgus
Consulting Engineer, New York

In giving consideration to the various plans that have been made public for the solving of the country's pressing railroad problem, it is well to bear in mind the ills with which the railroads are now afflicted. They may be briefly summarized thus:

1. Uncertainty in the minds of investors as to the integrity of capital legitimately invested in the railroads and the yield of a fair return thereon, with the result that the holders of securities are selling, and the flow of capital into much-needed railroad extensions and improvements has entirely ceased.

2. Lack of confidence between managements, employees, shippers, and the general public, with resulting suspicion and friction.

3. Loss of incentive on the part of officers and men for practicing initiative, resourcefulness, economy, efficiency and courtesy, in consequence of which there is dry rot coupled with unchecked rising costs of operation.

4. Political control, which vests the party in power with prerogatives dangerous to our institutions and destructive of good service to the public.

Through what agencies may these evils best be cured? Government ownership is generally condemned, and yet what the public really fears is not so much Government ownership as the well known evils that flow from Government management and operation. In fact, it may be said that private ownership under Government regulation and control, coupled with a Government guarantee in one form or another, as proposed in the majority of the plans so far offered, is in effect Government ownership without its simplicity and freedom from bankers' domination.

Necessary Elements of Plan

Whether through direct or indirect Government ownership, the remedies which the writer feels should be embodied in the adopted plan are:

1. Governmental assurance of a permanent policy in respect to the integrity of the public's investment in railroads, and of a fair return thereon, either (a) by the purchase of the properties at their fair value, or (b) by guaranteeing a minimum rate of return on their existing fair value and on securities properly issued in the future for extensions and improvements—all in such manner as justly to treat both the public at large and the investors.

2. Management of railroads through boards of directors embracing equitable representation of all parties in interest, including investors, employees, shippers and the general public.

3. Revival of the spirit of emulation and creativeness in officers and employees, and stimulation of the interest and coöperation of shippers and the general public, through an equitable division among them of surplus earnings, to the winning of which they would all contribute in their joint effort to attract patronage through courteousness and superior service.

4. Abolition of political control in the selection and

promotion of officers and men, which functions should be exercised by the aforesaid boards of directors.

An analysis of the leading plans that have been offered indicates that some of them err in proposing a higher rate of guaranteed return than is in the public interest; others would take from the more prosperous roads, without due compensation, a portion of their surplus earnings, in order that less fortunate or less efficiently operated properties might benefit therefrom; and others make no provision for the sharing by all interests in the management and profits of the enterprise. In fact, none of the better known plans meets all these desiderata.

Plan Proposed

The following plan is offered as one which will assure (a) the investor, of the safety of his principal and the return thereon; (b) the management, of a minimum fixed reward and the promise of a further reward for superior service; (c) the employee, of a voice in the management, a minimum fair wage and a share in the reward of good service to which his efforts would contribute; (d) the shipper, of a voice in the fixing of fair rates from which he would reap the reward of moderation through a share in the surplus, and (e) the public, through the stabilizing of railroad finances, of the minimizing of evils flowing from political control, the eliminating of scandals too often associated with private ownership, and, above all, efficiency of service:

1. Acquisition, by the national Government, of the railroads of the country at their fair value.

2. Grouping of the railroads so acquired into regional operating units, with sufficient interlacings of trunk lines to insure competition of service between important centers, and with due attention to the arranging of joint terminals where demanded in the interest of all concerned.

3. Leasing of the regional groups to private companies, under the sole direction and supervision of a department of the Federal administration to be created for that purpose; and under terms that will yield to such companies a minimum reward for their management of the enterprises, and in addition thereto a substantial share, say three-quarters, of surplus earnings in excess of operating expenses, taxes, depreciation, interest charges and amortization.

4. Provision for representation on the boards of directors of the private companies of all parties in interest, including the management, employees, shippers and the general public in the localities traversed; and for the equitable sharing among such interests of the aforesaid surplus earnings.

5. Extensions, enlargements and improvements of the properties at the expense of the Government on the request of the lessees, upon proof of necessity to the above-mentioned new Federal department.

6. Purchase of equipment by the Government as from time to time required and its allocation among the regional companies, under the direction of the aforesaid new Federal department.

7. Settlement of questions that cannot be brought to a conclusion locally, through three general boards under the aforesaid new Federal department, viz., a *Wage Board*, on which there would be equal representation of the national Government, speaking for the general public, employees of the country at large, and the leasing company or companies involved in any particular wage question; a *Rate Board*, on which there would be equal representation of the national Government, shippers at large, and the leasing company or companies affected; and a *Service and Improvement Board*, on which there would be equal representation of the National Government, which would furnish the funds, and the leasing company or companies affected; the decisions of such boards to be subject to the review of the head of such new Federal department.

Dutch East Indies Offer Many Construction Opportunities

Developments Now Under Way or in Prospect in Sumatra and Java Include Port Works, Railroads and Water-Power

By J. W. Evans
New York City

THE Dutch East Indies are making a call on American engineers and on American manufacturers of construction material and equipment. It stands out, among the similar calls which are reaching us now from many quarters, as peculiarly inviting. It is not too much to say indeed, that the Dutch East Indies offer in this respect certain opportunities which fairly compel investigation.

The Dutch East is an agricultural region which the pressure of war has suddenly awakened to its own vast industrial possibilities. As a result, great engineering and construction projects are being planned. Many of them are definitely under way; others are in prospect; and their number is constantly increasing as committees appointed by the colonial Government go further and further with their investigations.

To specify some of the more outstanding results, the expansion of the tobacco and rubber trade in Sumatra has led the colonial Government to the construction of a $3,000,000 harbor at Belawan, with great quays and warehouses, and including the dredging of a suitable channel. That enterprise is under way at the present moment.

Its most immediate result is a call for iron and steel concrete reinforcements from the United States. Its later results will be an immensely accelerated development and improvement of towns, installation of plantation equipment, and the calling for engineering help which is fundamental in any growing, developing region.

Effect of Ocean Transportation

Sumatra has already shown a disposition toward rapid development, but the bringing of transoceanic steamships right to those coasts will hurdle at a single leap one of the island's greatest handicaps. While we are on the subject of Sumatra it is worth adding that the Department of Public Works of the Dutch East Indies proposes to irrigate nearly 67,000 acres of land at Assahan on the Sumatra east coast. The work will cost about 6,000,000 guilders, and will create a large area of arable land suitable for the cultivation of rice.

Facts of this kind are a promise of other, bigger prospects later, for Sumatra, one of the most luxuriant, fertile regions in the world, is as big as California. It produces many things well and two superlatively so—wrapper tobacco and rubber.

But perhaps the most picturesque engineering project on foot in the Dutch East is the development of the Island of Celebes, where a deposit of iron ore reckoned at a billion tons has recently been discovered. The ore comes very close to the surface. In the neighborhood are stocks of nickel alloys covering an area of about 400 square miles. There are yields of common iron ore, chrome iron, nickel and manganese ore. The outlets of three lakes will furnish power for the working of these deposits. Plans are now being considered for opening up not merely the mines, but the whole rich agricultural region around them and for inviting capital—American capital, if possible—to go in there and help.

From the viewpoint of the American engineer and the manufacturer of construction equipment and materials, this means certain things, or will mean them before long: First, the installation of a railroad from the coast to the interior, with a call for engineering services and material. Second, the development of a great hydro-electric enterprise for working the mines —chance number two for America, the engineer and manufacturer. Third, the almost inevitable building and equipping of industrial plants, either on the coast or in the interior, to handle the ore of those great mines. Fourth, the building of shipping and terminal facilities on the coast for the handling of these products, and for their distribution either in raw or manufactured form throughout the Far East. Fifth, the settlement of the country, wherever the railroad may go, by immigration from overcrowded Java. And because Celebes is fabulously rich in agricultural possibilities, the things that will come from that condition will tend in the same direction that they have in Java—roads, towns, buildings, and all that goes with the opening of rich, new country—the sort of condition on which enterprising Americans grew rich in our own developing West.

Population of 50,000,000 To Be Served

But that's still in the future. Turn now to Java, with its area a third that of California and its enormous population of 35,000,000, about 750 to the square mile. The proportionate importance of Java in the archipelago may be understood when it is explained that the total population of the Dutch East is about 50,000,000.

Java, commercially, is 75% of the Dutch East. It has not meant much to us in the past—at least, we didn't know it did. We have always used its products —rubber, tea, coffee, quinine, cocoanut oil, copra, fibers and the like—but we got them by way of European middlemen. The war, closing the trade routes between the archipelago and Europe, forced us to exchange our manufactured goods for their products direct. Before the war they used to get their manufactured goods from Europe; but under the new conditions they found the American article was the best they ever tried. Now they are clamoring for a continuance and an increase of this newly developed trade, pointing out that it will be a source of economy both to them and to us.

And they want everything from automobiles and locomotives to pins and tiddlywinks. Not only is the colonial Government encouraging every kind of construction work, and doing lots of it itself, but the native standard of living is going up by leaps and bounds. Where the natives used to be tickled to death with a string of beads or a pocket mirror, they are now beginning to want phonographs and modern conveniences. There are three cities in Java which are now calling for 47,000 tons of iron and steel pipe for water mains; and that means the big lines only. It takes no account of the further need for smaller sizes. And of course it takes engineers to put such things in.

Investigations are being made for new developments by hydro-electric power in Java. New railroads are being built. Only recently the colonial Government ordered 12 locomotives in the United States, at a total cost of $600,000.

They are even establishing shops of all kinds for making small machine parts and are calling for machine tools, a thing which machine-tool makers never expected from that part of the world. Certain engineering works in Surabaya have, for instance, begun the construction of all appliances necessary to secure the safety of railroad traffic. Other works are constructing iron frameworks for houses.

Engineering Congress Next May

The Government is making investigations now into what industries may be established to advantage, and the data will be presented at an engineering congress which is to meet next May, prior to the industrial fair which will be held at Weltevreden, a town near Batavia. The discussions at the congress will be in English; and it will afford an opportunity to American engineers and representatives of American manufacturers of construction material and equipment to be present in an advisory capacity and make clear what they have.

The area of the Dutch East Indies archipelago is 750,000 square miles. Of this total 500,000 is still to be developed. The length of the archipelago is 3000 miles. It is a great field for commerce; its future is as certain as is the world's need for the products of the Dutch East. It offers immediate opportunities in construction work and is bound to offer others enormously greater in a very short time.

No American construction man can afford not to give the Dutch East careful study and attention. The Netherlands Indian Government Intelligence Office at 11 William St., New York City, is always in touch with conditions and is glad to furnish information.

City Zoning Authorized in Oregon

Any incorporated city or town in Oregon is authorized by recent state legislation to enact a zoning ordinance. Such ordinances may place restrictions on the height and bulk of buildings and on the percentage of the lot which they may occupy, and may designate use areas or districts. Where city-planning commissions exist the council shall require the commission to recommend zone boundaries, after advertised public hearings, and the council may not fix such boundaries until after the commission has made its report and public hearings on the subject have been held. Where there is no planning commission, the council first proceeds as a commission would, then acts as it would do after a commission had reported to it.

Wind Pressure on Cylindrical Structures in Practice

Methods Applicable to Various Problems of the Structural Designer in Dealing With Chimneys, Stacks and Standpipes—Proportioning Anchor Bolts—Guyed Steel Stacks

By R. Fleming
American Bridge Company, New York City

THE object of this article is to present a sane and practical treatment of designing methods applicable to cylindrical structures such as stacks and standpipes. Gasholders are not considered, as the special questions of structural analysis which they involve would carry this article beyond its proper scope.

The fundamental formula for wind pressure is

$$P = kDSV^2 \qquad (1)$$

in which P is the total pressure on a plane surface of area S normal to the direction of the wind, k is a constant determined by experiment, D is the density of the air (varying with the altitude), and V is the wind velocity. The United States Weather Bureau uses 0.004 for the value of k when P is expressed in pounds, S in square feet and V in miles per hour. For heights not greater than those of steel structures D may be assumed as unity. The wind pressure, $p(= P/S)$, in pounds per square foot on a flat surface normal to the direction of the wind for any velocity, V, in miles per hour, is therefore given by the formula

$$p = 0.004\,V^2 \qquad (2)$$

For the intensity of wind pressure P_n on a plane surface inclined at an angle A to the direction of the wind, the formula generally accepted is that of Duchemin,

$$P_n = P\frac{2\sin A}{1+\sin^2 A} \qquad (3)$$

Duchemin's formula has been so well established that its correctness need not be questioned.

Wind Pressure on Cylindrical Surfaces

What is the wind pressure upon a cylindrical surface? Rankine, in his "Applied Mechanics," states, without giving reasons:

> The total pressure of the wind against the side of a cylinder is about one-half of the total pressure against a diametral plane of that cylinder.

Rankine's statement has been accepted without question by many writers, but few of them mention that he regarded 55 lb. per square foot as the correct pressure to be assumed for wind normal to flat surfaces. Most engineers think this figure excessive.

Spofford, in "The Theory of Structures," treats a cylinder as an infinite series of tangential planes, as did Fanning before him in "Water-Supply Engineering." He assumes that the intensity of wind pressure upon inclined surfaces varies as the square of the sine of the angle of incidence, and integrating between limits $-\frac{\pi}{2}$ and $+\frac{\pi}{2}$ he determines the pressure on a cylinder to be equal to two-thirds that on a plane, at right angles to the direction of the wind, whose area is the height of the cylinder multiplied by its diameter.

Both Fanning (who deduced the factor one-half in place of two-thirds) and Spofford are wrong in their underlying thought. As far as the summed effect of wind pressure is concerned the cylinder is not an infinite series of tangential planes. Incidentally, the Duchemin formula, when P_h equals the component of P_n parallel to the direction of the wind, becomes

$$P_h = P\frac{2\sin^2 A}{1+\sin^2 A}.$$

Integrating this equation between the limits $-\frac{1}{2}\pi$ and $+\frac{1}{2}\pi$ makes $P_h = 0.91\,P$, or, the wind pressure on a cylinder is equal to 0.91 that on a plane diametrical section, a result disproved by experiment. Moreover, it has long been demonstrated that the theory of the square of the sine of the angle of incidence is false: if it were true for slight inclinations, aviation would be impossible.

In Eiffel's "La Résistance de L'Air" and in the German "Hütte," values of the ratio of P_h to P are quoted from 0.45 to 0.785. Most German engineers use two-thirds. American specifications variously use values of one-half, six-tenths and two-thirds.

Loenig, in "Military Aëroplanes," is to be commended for giving k for all forms of profile instead of expressing their air resistance as a percentage of the resistance of a flat square normal surface under the same conditions. For cylinders with axis at right angles to the direction of the wind and one diameter long he gives k a value of 0.00092; four diameters long, 0.0017; seven diameters long, 0.002; 35 diameters long, 0.0025.

After considering the available data on the subject, the writer recommends that wind pressure on cylinders be determined by the formula

$$p = 0.0025\,V^2 \qquad (4)$$

in which p is the pressure in pounds per square foot of projected area (diameter multiplied by height) and V is the wind velocity in miles per hour. The velocity of wind increases with the height, but no satisfactory law stating this relation has yet been formulated.

Self-Supporting Steel Stacks

A common case of wind pressure on cylindrical surfaces is that of self-supporting steel stacks. The wind effect is the dominating factor in their design.

Wind velocities vary greatly. At Mobile, Ala., along the Gulf coast, the highest velocities recorded by the United States Weather Bureau in the year 1916 were 107 and 115 miles per hour. At Anniston, in the interior of the state, 250 miles distant, the highest velocity recorded during the same year was 32 miles per hour. The highest velocity in New York City during the period 1884-1917 inclusive was 96 miles per hour.

However, the recorded velocity is not the actual velocity. A recorded velocity of 90 miles per hour means, according to the United States Weather Bureau reduction formula, an actual velocity of 69.2; a recorded velocity of 100 miles per hour means an actual velocity of 76.1. But, as Bixby says in his monograph on wind pressure, reprinted in *Engineering News* of Mar. 14, 1895, p. 175:

> It is to be remembered that all high wind velocities may be subject to repeated oscillations of from 30 to 40% each way from the average at half-minute intervals for several minutes, and sometimes even to an increase of 60% for

nearly a whole minute; so that it is not unreasonable to assume the velocities of occasional gusts to be as high as those given by the records of the ordinary cup rotary anemometer.

Oscillations may be started easily in stacks and chimneys, though the wind pulses are relatively slow.

Wind velocities of 90 and 100 miles per hour correspond, by formula (4), to pressure intensities of 20 and 25 lb. per square foot, respectively. In his own specifications the writer requires:

> Circular steel stacks and tanks shall be designed to resist a wind pressure of not less than 20 lb. per square foot of projected area; that is, the diameter multiplied by the height.

For stacks of great height and in locations exposed to exceptionally high winds, 25 lb. should be used. This was done in the design of the largest self-supporting steel stack in the world—that at the plant of the United Verde Copper Co., Clarkdale, Ariz. The stack, built by the Chicago Bridge and Iron Works, has a height of 400 ft. and a diameter of 30 feet.

The wind stresses in a cylindrical steel stack may be determined by considering the cylinder above any assumed horizontal plane section as a cantilever beam. If the stack is H feet high above this plane, has an outer diameter of D feet, and is subjected to a pressure of p pounds per square foot of projected area, the bending movement is

$$M = HD \times p \times \frac{H}{2} = \frac{H^2 Dp}{2} \qquad (5)$$

from which the stress S in the extreme fiber may be determined by the fundamental formula for flexure, $S = Mc/I$, which is to be applied after multiplying M by 12 so as to reduce to inch-pounds, and with values of the moment of inertia I and distance c from neutral axis to extreme fiber also given in terms of inches. The moment of inertia, I, of the plane section or hollow circle about a diameter is

$$I = \frac{\pi (d^4 - d_1^4)}{64} = \frac{\pi (d^2 + d_1^2)(d + d_1)(d - d_1)}{64} \qquad (6)$$

in which d and d_1 are outer and inner diameters of shell in inches. Then, as $d - d_1$ is twice the thickness of shell in inches, and since the shell being thin there is no appreciable error in replacing $d + d_1$ by $2d$ or $4r$, and $d^2 + d_1^2$ by $2d^2$ or $8r^2$, we have $I = \pi r^3 t$, and as $c = r$ we then have $I/c = \pi r^2 t$. Using this value, and taking the bending moment M in foot-pounds, the diameter D in feet, and the shell thickness t in inches, we derive the formula

$$S = 0.106 \frac{M}{D^2 t} \qquad (7)$$

and the bending stress for each circumferential inch is

$$St = 0.106 \frac{M}{D^2} \qquad (8)$$

To this bending stress should be added the weight of the stack per circumferential inch, W/12πD, to obtain the total compressive stress (subtract for tensile stress). However, unless the masonry lining is carried by the shell this weight item is neglibible.

Tension is usually the governing factor with respect to plate thickness. The efficiency of horizontal riveted joints in regard to net section of plates ranges from 65 to 85%. For rivet shear and bearing the compressive stress governs.

Stacks are built for durability as well as strength, and to secure this many engineers use low working stresses. If the usual working stresses were followed plates would often be thin and rivets far apart. The writer recommends working stresses of 12,000 lb. per square inch net tension and 10,000 lb. per square inch gross compression. To the thicknesses of plate thus found he would add not less than $\frac{1}{16}$ in. for corrosion but would use no plate less than $\frac{3}{16}$ in. (preferably $\frac{1}{4}$ in.) thick.

The total horizontal shear on any section is HD. The maximum unit horizontal shear occurs at a point on the circumference 90° distant from the point of maximum tension or compression from bending moment. At the point of maximum moment in any horizontal section the unit horizontal shear is zero, and vice versa. Therefore, the maximum in the case of either stress is not increased by the other kind of stress.

A possibility that should not be overlooked in designing steel stacks is the collapse of the shell during windstorms. In stacks of only a few feet diameter this possibility is quite remote, but those of large diameter may require special provision to guard against it. The case is similar to that of empty standpipes, considered later.

Anchor Bolts—Fully a dozen methods have been proposed for determining stresses in anchor bolts. Textbooks differ widely on the subject. The problem is not one of pure mathematics, as the solution depends upon the physical conditions of the stack, base and bolts.[1] The most severe condition is when the bolts are screwed up with a high initial tension. The anchor-bolt ring may then be considered a ring of the cylinder and, in accordance with eq. (8), the maximum uplift per circumferential inch is $\frac{0.106\ M}{D^2}$, M being the bending moment in foot-pounds at the base of the stack from wind and $D = 2R$, the diameter in feet of the anchor-bolt ring. If b be the circumferential distance in inches between anchor bolts the maximum wind stress, S_w, in each anchor bolt is

$$\frac{0.106\ bM}{(2R)^2} \qquad (9)$$

From eq. (9) should be deducted the weight of that portion of the stack between adjacent anchor bolts, W/N, W being the total weight of the stack and N the number of anchor bolts. Therefore the maximum tensile stress in any anchor bolt may be expressed by

$$S_a = \frac{0.106\ bM}{2R^2} - \frac{W}{N} \qquad (10)$$

Since $b = 2R \times 12 \times \pi/N$, eq. (10) reduces to the simple form,

$$S_a = \frac{2M}{RN} - \frac{W}{N} \qquad (11)$$

In accordance with the previous notation M is in foot-pounds and R in feet, but the equation is true for M in inch-pounds if R is in inches.

With the above rather severe assumption of physical conditions in determining anchor-bolt stress, the tensile working stress may be taken at 18,000 lb. per square inch net section, from which the diameter of the bolt is easily obtained.

High Brick Chimneys—The brick chimney built by the Alphons Custodis Chimney Construction Co. for the

[1] See an able editorial discussion following an article, "Anchor Bolt Tension," in *Engineering News* of Apr. 30, 1914, p. 956.

Boston & Montana Consolidated Copper & Silver Mining Co. at Great Falls, Mont., in 1908, was for a time the highest chimney in the world. It is 506 ft. high above its foundation, and the inside diameter at the top is 50 ft. The cylindrical portion was designed to resist a wind pressure of 33⅓ lb. per square foot of projected area. The height of the chimney, its altitude above sea level and the severe winds prevalent in the region determined the choice of this unusual wind pressure. For a detailed description of this chimney, with calculation of wind stresses, see *Engineering Record* of Nov. 28, 1908, p. 600.

A taller chimney, 572 ft. 10 in. high and 25 ft. inside diameter at the top, was built by the Custodis company in 1917 at Tacoma, Wash., for the Tacoma Smelting Co. In 1918 the same company completed the present record chimney of the world at Anaconda, Mont., for the Anaconda Copper Co. This chimney is 585 ft. 1½ in. high above grade and 60 ft. in inside diameter at top. The same wind data were used for the Tacoma and Anaconda chimneys as for the Great Falls chimney.

Oscillations of Saganoseki Chimney

The reinforced-concrete chimney, 570 ft. high and 26 ft. 3 in. inside diameter at top, built in 1916 by the Weber Chimney Co. for a smelter plant at Saganoseki, Japan, held for a time the record as being the world's highest chimney. The design included provision for earthquake stresses as well as stresses due to wind. In determining the latter the wind pressure was assumed at 25 lb. per square foot of projected area.

Some observations made by Professor Omori on the movement of the top of this chimney when subject to wind pressure are worthy of note. (See "Vibration of Reinforced-Concrete Chimneys," by F. Omori, "Bulletin" of the Imperial Earthquake Investigations Committee, Vol. 9, No. 1, Tokyo, March, 1918.) During the five days throughout which the observations were continued, wind velocities were recorded ranging from less than one mile per hour to a hurricane velocity of 78 miles. The amplitude of vibration was found not to vary as the square of the velocity, for at a velocity of 50 miles per hour the complete range was less than 1 in., while at 78 miles per hour it was 7.32 in. Strange to say, for the velocity of 78 miles the maximum amplitude was in a direction at right angles to that of the wind. Professor Omori thinks that with the wind gusts of 110 miles an hour which they occasionally have in Japan the amplitude would be at least 15 in. The period of vibration was nearly constant for all velocities, varying only from 2.52 to 2.56 seconds.

An important conclusion reached by Professor Omori was that wind pressure on tall chimneys may be more disastrous in its effects than seismic motion. The observed motion of the Saganoseki chimney indicated a maximum acceleration of 22.2 in./sec.², while the maximum acceleration during the Tokyo earthquake of June 20, 1894, was 17.5 in./sec.². In his summary, Professor Omori says: "It thus appears that in a locality where the earthquake motion is not very violent and has an acceleration, say, of under 19.7 in./sec.² the effect of the wind pressure on a tall chimney becomes more important than that of seismic motion."

A common method of holding a steel stack in position is by securing guy wires to a band or ring around the stack and anchoring them to footings some distance from its base. By these cables the wind pressure on the stack is carried to the ground. This allows the stack to be built of lighter material than if self-sustaining. Theoretically, the guys should be adjusted so that the horizontal components due to initial tension are the same at all attachments. As the calculations for such adjustments are elaborate and physical conditions uncertain, approximate methods must be employed to determine tensile stresses in the guys.

Guyed Steel Stacks

Christie, in his "Chimney Design," quotes from "Engineering Mechanics" a rule of thumb for finding the diameter of guy wires for steel chimneys, but gives us no hint as to how this rule is obtained. Moreover, in the original article the rule is given as applying to wrought-iron rods. Rods are now seldom used for guys, their place being taken by wire cables. In Marks' "Mechanical Engineers' Handbook," under the subject "Guyed Steel Stacks," the wind pressure is assumed at 25 lb. per square foot of projected area. The author assumes that there are always two sets of three guys, that the guys make an angle of 60° with the vertical, that the wind pressure is 25 lb., and that the stress is equally divided among the guys. He further allows for an initial stress equal to half the wind stress. The resulting equation is very limited in its application. Guys are seldom placed at an angle of 60° with the vertical, and the stress may not be divided equally among the guys.

For stacks guyed with either three or four cables in a set the writer recommends the following method for determining the maximum tension in the guys:

Let D be the diameter and L the height of the stack, in feet; H_1, H_2, H_3, etc., the points of attachment of the guys; h_1, h_2, h_3, etc., the heights of these points; and A_1, A_2, A_3, etc., the angles which the guys make with the vertical. At 20 lb., the wind pressure between any two points of support, as H_2 and H_1, is $20\,D(h_2 - h_1)$. The horizontal reaction from this pressure is assumed to be $\frac{6}{10} \times 20\,D(h_2 - h_1)$ at each attachment. The factor $\frac{6}{10}$ is used instead of $\frac{1}{2}$ because the guys are liable to be unequally adjusted, thus bringing on one wire more than its share of pull.

The horizontal reaction at the upper point of support is the entire pressure above that point plus the $\frac{6}{10}$ pressure between that point and the nearest support below. These horizontal reactions multiplied by the cosecants of the respective angles made by the guys with the vertical gives the stresses in the guys due to the wind. To these values should be added the initial tension; from 2500 lb. for ½-in. cable to 5000 lb. for ¾-in. cable is considered ample for initial tension.

The vertical components of the tensile stresses in the guys (consideration being given to eccentricity of connections) should be added to the weight of the stack for the total direct compression stress.

Bending stresses due to wind pressure may be determined by considering the stack as a series of uniformly loaded beams supported at the guy bands and base of the stack. The bending stress in any section may be determined by eq. (7), $S = 0.106\,M/D^2t$. The maximum value of M (except for the upper section when it is a cantilever) is $M = \frac{1}{8}pD(\frac{1}{2}h)^2$, in which h = distance in feet between supports of the section considered. The distance h between points of support is increased 20% for the reason given above in using

the factor $\frac{6}{10}$ instead of $\frac{1}{2}$ to get horizontal reactions.

The "Standard Dictionary" defines a standpipe as a tower-like pipe at a reservoir, or other source of water, into which the water is pumped to give it a head. Its height in most cases is considerably greater than its diameter; it has a flat bottom and rests directly on its foundation. The governing factor in the design of standpipes is the internal pressure of the water. But wind stresses should not be neglected.

Standpipes have largely ceased to be used as a part of the water-supply equipment of municipalities. Unless the location is sufficiently elevated for a standpipe of large diameter and shallow depth, it has been found that for the same cost more water can be stored at an effective height by a water tower than by a standpipe. A lengthy record of failures of standpipes of the old type, mostly due to faulty design, has created a feeling of distrust. As long ago as 1895, in his book, "Stand-Pipe Accidents and Failures," Professor Pence discussed 45 failures. Several of these were caused by wind, either the anchor bolts gave way or the shell collapsed when the tank was empty.

In reference to collapsing of the shell the Birch-Nord "General Specifications for Standpipes, Tanks and Towers"[2] has a clause:

"On large tanks, circular stiffening angles shall be provided in order to prevent the tank plates from buckling during windstorms. The distance between the angles shall be determined by the formula:

$$d = \sqrt{t}\,\frac{900}{D}$$

where d = approximate distance between angles, in feet; t = thickness of tank plates, in inches; D = diameter of tank, in feet."

The minimum thickness of plates forming the sides is specified as $\frac{1}{4}$ inch.

Water tanks of large diameter are often stiffened at the top by a lattice-girder ring.

Wynkoop Kiersted, in a paper read many years ago before the Rensselaer Society of Engineers[3] recommended as an approximation that the steel plate be regarded as a thin beam having a span of one-half the tank diameter, and loaded by the wind pressure. This method gives thicknesses greater than those used in ordinary practice. If the wind pressure be assumed as 20 lb. per square foot and the efficiency of a riveted joint as $\frac{5}{8}$ of the solid plate, so that the effective working stress is $\frac{5}{8}$ of 16,000 or 10,000 lb. per square inch, the required thickness of the plate in inches equals $\frac{1}{50}$ (nearly) of the tank diameter in feet. That is, for a tank of 25-ft. diameter the minimum thickness of shell is $\frac{1}{2}$ in. Such a requirement is needlessly severe. It is cheaper to use thinner plates and provide against buckling by means of circular stiffening angles.

Storage Tanks

There is no well defined line between the standpipe and the flat-bottom storage tank. When water is stored the terms are often used interchangeably. When oil, molasses or other liquids are stored the term "storage tank" is used exclusively.

As storage tanks are usually of comparatively low height and large diameter, it is permissible to assume a less wind pressure than for stacks and tanks of considerable height. For tanks resting on their own foundations, not more than 25 ft. high, and of diameter not less than one-half the height, a wind pressure of 15 lb. per square foot on the projected vertical area is ample.

[2] "Transactions," Am. Soc. C. E., Vol. LXIV, pp. 526-566, September, 1909.

[3] *Engineering Record*, Vol. XXIII, p. 366, May 2, 1891.

Arrangement of Equipment in Engineer's Office

Adjustable Table, Lights and Dictionary Stand—Special Cases to Protect Instruments—Generally Neat Appearance

By Hiram P. Farrow
Civil Engineer, Belfast, Me.

A SET of photographs of my office which were recently taken are shown herewith. They may possibly be a basis of suggestion to some members of the profession. Taking them in their serial order, they afford a very good panorama of the inside of the room. No. 1 shows the case for field instruments, two transits and one level. It will be noticed that the base under the level is raised so that the level is above and projects over the transits, thus permitting the use of a much narrower case.

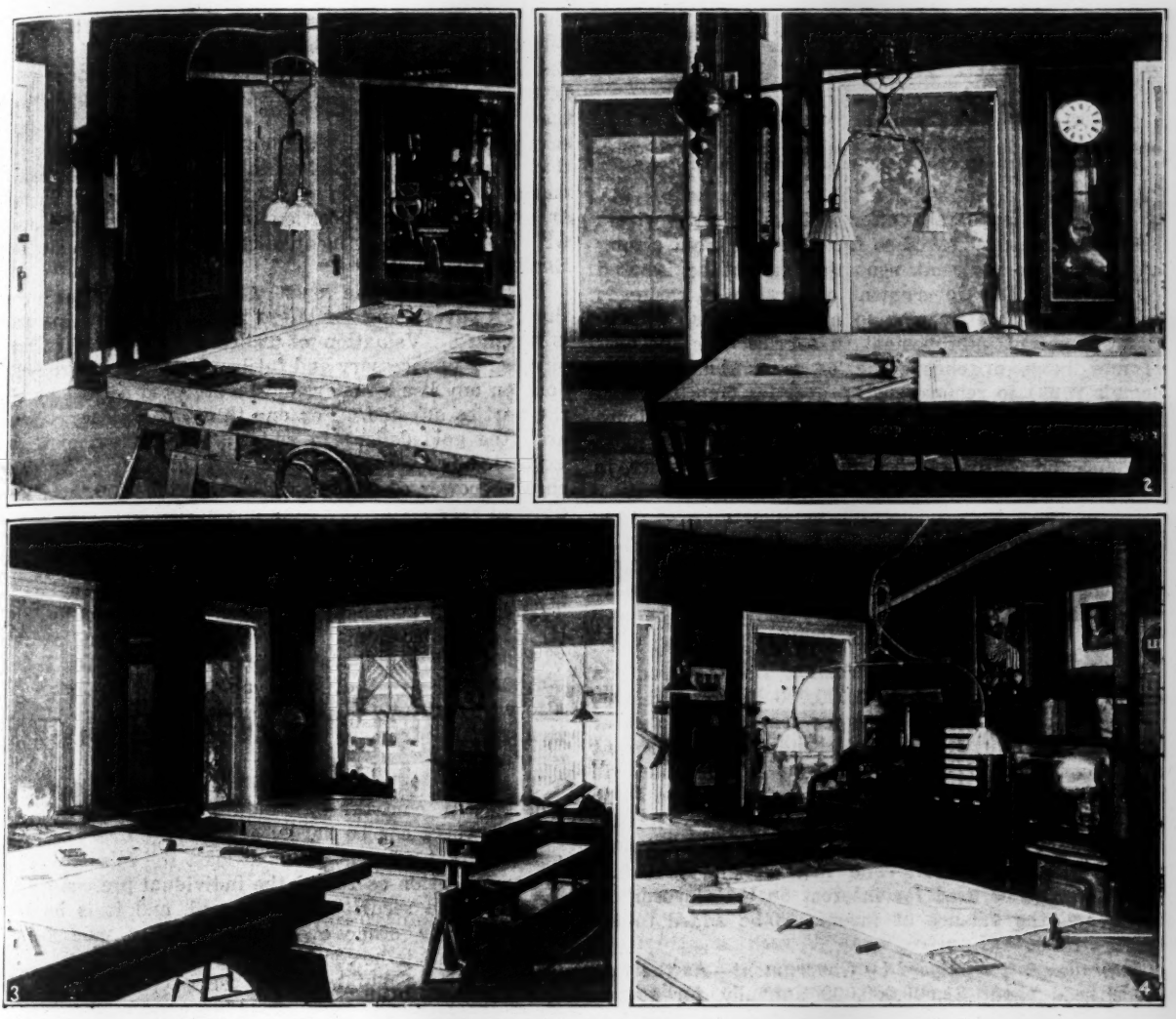
The case is joined together with lagbolts, which make a cheap, neat and solid fastening. This makes a convenient and effective protection for the instruments. This illustration also shows a showcase with glass front (formerly used for a banner) wherein are placed the table instruments. They are easily placed out of the way, always in sight and free as possible from damage. There is also shown the arrangement for changing the height of the table.

The fact that the clock case and thermometer as shown in No. 2 were home-made is of no special interest, but this picture gives the best idea of the adjustable lighting apparatus as designed and built by the writer. The crane adjusts for different heights by sliding up or down on the rod seen attached to the post, being balanced by the ball counterweight as shown (formerly the central part of a chandelier). The track or arm of the crane is of carriage-tire steel, and the swivel under the ball carriage is made of two double-light wall gas fixtures. Note that it carries two lights, thus eliminating shadow. If it is wished to change the distance between the lamps, it can be done easily by sliding the tubes in their sockets under the swivel.

As mentioned above, the lights are immediately adjustable as to height as the counterweight holds them at any point, and by means of the swinging crane, sliding carriage and swivel support the light can be brought to any point by a touch without anything resting or dragging upon the work.

The advisabilty of procuring a patent has been suggested to the writer, but he prefers giving the benefit of it to such members of the profession as may choose to avail themselves of the idea. He should not object, however, should they choose to recognize him by calling it by his name.

In No. 3 are shown the globe in the corner with its support—which is adjustable for height without effort—the little wall shelf to which is permanently attached



VIEWS OF ARRANGEMENT OF ENGINEERING OFFICE

1. Instrument cases drafting table and lighting arrangement; 2, counterweights for raising and lowering light, at left; 3, view of office from different angle; 4 clerical section of office

the paper fastening apparatus, the device arranged from a gas fixture for suspending the hanging light at other points where needed, the substitute for the usual high stool—by means of which one can change his position at work without getting down and which is easily changed as to height—and also the dictionary holder devised and built by the writer, using the top of the holder now in common use. It need not be told what an abomination the ordinary stand is about the floor, the height being such that it is never convenient for use when one is either standing or sitting, likely to be upset and always in the way of cleaning. As here shown it is supported by an iron pipe with an elbow and a flange at the bottom secured to the baseboard by lag-screws. As shown, it is drawn down to be used by a person in a sitting position, and it is balanced by the counterweight which, by means of the gears, does its work on the same side as the load, thus permitting the placing of the apparatus close to the wall; this could not be done were the counterweight on the end of a simple lever opposite the book. No. 4 shows the holder erect for use when one is standing, and shows also the cabinet for typewriter papers over the machine, also the cabinet for legal blanks, with drawers for card index.

If any of the readers of *Engineering News-Record* can obtain useful hints from the above I shall be repaid.

Light Railway Benefits Arabian Port

One of war's benefits to Arabia has been the completion of a narrow-gage railway, approximately 30 miles in length, from Aden, the seaport of Arabia, to Lahej capital of the Abdali tribe in southwest Arabia. The first eight miles were built in 1915 as a supply route for British forces operating against the Turks in that region. The remainder is an after-the-armistice development. All work was done by the Royal Engineers. With the completion of the line to Lahej, its extension to the Yemen plateau, 200 miles north of Aden, where the world's supply of Mocha coffee is grown, becomes a matter of serious discussion, according to *Commerce Reports* of Aug. 14.

Plan to Finance Federal Purchase of Railroads

By Gustav Lindenthal
Consulting Engineer, New York

(Part of a letter addressed to Senator Albert B. Cummins, chairman of the Senate Committee on Interstate Commerce.)

YOUR plan for restoring the railroads to private ownership appears to offer on the whole the wisest and most practical method so far mentioned, but strong political forces and sentiment that cannot be ignored are clamoring for Government ownership of railroads and of public utilities, not so much, perhaps, because of any expected improvement in service over the best we now have, or cheapening of rates, but (as the formula runs) to remove such properties from the field of exploitation by private capital. There is evidence from day to day that this demand will become more insistent and if disregarded may lead to injustice in legislation, perhaps even to confiscation of property.

Therefore I suggest certain modifications of your plan, having for their object the gradual acquisition of all railroads in the United States through amortization. This latter is of course not a new idea except as to some details.

Bonds To Be Issued

Tax-Free Convertible Government Bonds—Create a sinking fund nucleus of $500,000,000 by gradual sale, as needed, of 3% tax-free 10-year convertible bonds at par (this is the same as selling bonds of 4½% interest with income tax of 33⅓% deducted). Such bonds will be very readily taken for reasons given below. The proceeds (or the bonds themselves) to be used for the gradual buying up in *the open market* of railroad securities, stocks and bonds. The interest and dividends from them to be used for interest on the Government bonds and the balance of income to be added to the sinking fund.

Improvements Financed by Government—As the railroads need about $1,000,000,000 annually for several years, to pay for necessary improvements and additions (especially for modern labor-saving terminals in which all railroads are deficient), the Government to make loans to the several railroads (or groups of railroads respectively) also in the form of 3% tax-free 10-year convertible bonds at par, but *only after* such improvements from time to time have been made. Their actual cost, including the legitimate item of higher interest which the railroad companies may have to pay for credit during construction, will then be accurately known in each instance from the accounts. Thus the bonds will be issued for *actual value produced.*

Avoiding Valuation

Securities Bought in Open Market—The railroads to be allowed to earn a surplus of at least ½% above the requirements for dividends and interest, including that on said tax-free 3% Government bonds. This surplus to be added to the sinking fund.

[In explanation of the term "requirements for dividends," Mr. Lindenthal informs us that this refers to the normal pre-war rates, not those of the best years nor those of the worst years. The "three-year test period" rates selected by Mr. McAdoo would determine them. Individual adjustments of these three-year rates would be necessary in order to deal fairly with all roads, and these would need to be fixed by separate study of particular cases. During the three-year test period some railroads were paying dividends less than their surplus earnings, and put the difference into betterments. Other roads were disbursing more than their surplus earnings. The plan is to maintain the earned pre-war surplus rather than the dividend rate that may have been fixed more or less by the company management; this with a view to avoiding any disturbance of the relative position of the several roads, and with a view to giving justice to the stockholder.—Editor.]

By buying in the open market, or if necessary through advertising for offers in the usual way, no one is wronged. Valuation of railroad property for that purpose is unnecessary and futile. It cannot be properly done on any basis that would be accepted as just by all the parties affected. For one thing, the money standard (the gold dollar) in which all valuations must be expressed is not a stable standard of value. Its purchasing power of labor, credit, material, land, etc., has differed very materially from one period to another during the 90-year era of railroad construction.

Before 1880 a dollar purchased 10 hours of common labor. In 1910 six hours. In 1918 only two hours. Take a recent instance: The construction work finished on the Pennsylvania R.R. two years ago costing $150,000,000 would cost at present prices over $300,000,000. The cost of cash capital (interest thereon) also varied greatly during the era of railroad construction, running from 10 to 20% and even much higher in emergencies.

Therefore, valuation of railroad property means in most cases controversy leading to long litigation, whereas there can be hardly any dispute over what the going market value is. It is at least the fairest method of compensation as far as the individual present holder of a railroad security is concerned, and it is he who has, like any other owner of property paid for, a primary right to be considered.

The railroad builders and the people, through its legislatures, in the past and gone generations, had at least equal responsibility for any shortcomings in the development of our railroad systems. They should therefore not be visited upon the present generation—upon the innocent investor, who put his savings in good faith in railroad securities and who has a right to expect that he will not be robbed of them through unjust legislation. On the other hand, the investor has no good reason to complain when he gets the price set in the open market; provided, of course, that it has not been impaired by unjust Government action nor manipulated by dishonest corporate management.

One of the great defects in the past was the granting of perpetual franchises. It was overlooked, or rather not understood by legislators unversed in national economics, that it might lead to the feudalization of railroad property, with all the attendant evils. This can be best corrected and abolished through amortization.

Rates Adjusted Annually—The transportation rates of the respective railroads should be adjusted each year on the equitable principle that as wages increase or decrease plus taxes, rentals, and other items of expenditures, so the rates shall also increase or decrease in like proportion. If the resulting net revenue applicable to dividends and interest plus the surplus (entirely applicable to amortization) is greater than

needed, then let the rates be either correspondingly reduced or let the surplus go in the sinking fund for faster amortization. This is a matter of administration policy, to be determined from year to year. A guarantee of net income under such just conditions is not necessary. The Government will get the benefit of any surplus and not the investor. That question, whether the railroads with ample income should support those with insufficient income, could be solved by amortizing, buying up first the weak railroads at market values.

Regulation

Each railroad should ascertain on that equitable principle its own rates and submit them at stated times with an analysis to the Interstate Service Commission for scrutiny and approval. That should not require more than a month's time. There has been much complaint of the unjustified delays in dealings with Governmental bodies and authorities. Long-drawn-out hearings on trivialities are a great and unnecessary waste of time and money, and a nuisance. They cloak incompetence and unfitness in executive and administrative work. The railroads as well as the public should be protected against that abuse by a law requiring decision within one month after submission, or, failing that, to have permission to go ahead pending adjustment.

The present Federal regulative apparatus of the Interstate Commission might be retained during amortization—not because it could not be much improved, but to avoid confusion. In regard to state railroad commissions, the rule might be adopted that their orders and decisions shall be valid only when approved by a Federal court after examination of their bearing upon interstate commerce which must not be impaired by them.

The creation of new agencies would entail new regulations and much delay. Let us get along on present lines with a minimum of new legislation. Among these should be the repeal of clauses prohibiting pooling and combinations of railroads for purpose of economical administration.

Railroad Taxation—Through amortization as above indicated, the Government will acquire all railroads free from debt and without cost in less than 45 years. This gives plenty of time for evolution into a new order of things, and for the formation of a truly *national transportation system on land and water and in the air*, under a Secretary of Transportation who should be a cabinet officer. During this time, and also after amortization when title shall have passed to the Government, the railroads shall continue to pay all taxes, Federal, state and municipal. They form an indispensable income to the respective localities. The rates for transportation shall not be reduced after amortization. It would be an unwise policy of no benefit to the country at large. Let the entire net income ordinarily used for dividends and interest go into the United States Treasury toward reduction of general taxation. Freedom from taxes and the reduction of established rates after amortization would benefit comparatively only the noisy few—the shippers, at the expense of the masses. It is the whole people, the general taxpaying public, that should be considered and benefited.

It would be equally wrong and inequitable to distribute net earnings, as has been suggested by labor interests, among employees as a largess above their regular compensation. *The national property should be for the benefit of the whole people and not for any particular class, be it capitalist or wage-earner.*

Management

Present Boards of Directors to Manage—The management of the several railroads, or of the groups of railroads that would naturally form, if let alone, by gradual accretion, should remain during and after amortization in the boards of directors. The directors become simply trustees of the Government. It would be a wise provision to have them after amortization nominated by local chambers of commerce from among experienced railroad managers and local business men. The nominations should be acted upon, rejected or affirmed, by the Interstate Commerce Commission or by a Secretary of Transportation.

Directors thus appointed should serve for, say, three years, not so much for the salary, which should be adequate, but for the honor of the position. Being under the scrutiny of the Government and also of local bodies, knowing local conditions and needs, they would be keenly interested in obtaining good, competitive service at low rates and in keeping down general expense and taxation.

Salaries a Percentage of Net—The compensation of all executive officials, from the president of the company down, should be left, as now, to the respective boards of directors, but the aggregate sum of compensation for any railroad group should be fixed at a certain percentage of net earnings, to furnish an incentive to good management.

Justice to Investor—One of the greatest benefits of amortization will be the flowing back of the large yearly sums as new capital that must then find new investment. About thirty thousand millions would thus be set free from railroads alone during the next 45 years to stimulate new enterprises and new construction which will lead to the continuous creation of more wealth and comforts.

Through amortization the investor in railroad securities will be assured that he will get his money back automatically and without tedious costly proceedings. He may be disappointed in perhaps not getting the greater amount that he may have expected from his investment in the certain growth of the railroad business. But he will get no less than what the open market judges his security to be worth.

Operation for Benefit of Nation—The manufacturer finding his costs increasing adds them to his price. The wage earner finding cost of living steadily mounting insists upon and gets higher wages. But the millions of men and women who have invested their savings, either directly or through savings banks and insurance companies, in railroad securities, cannot increase their earnings from their investments. They must practice still greater self-denial to get along with the greatly reduced purchasing power of their fixed income, and be thankful if they are not accused, under the new tenets that are being preached upon property, as robbers who want to fatten upon the land without giving an equivalent. The assailants of corporations overlook that the old and helpless and the young, consuming and not yet producing, members of the community, who are sustained from such invest-

ments, have at least an equal, inalienable right to life with the greedy hunter and agitator for low fares and rates, and the egotistic agitator for higher and higher wages.

Sordid selfishness will be found on both sides of the fence of Government ownership. *National revenue-producing property should be run strictly as a business concern. The revenue should go to the United States Treasury for the benefit of the whole people, without favors or exceptions to any class.*

POSTSCRIPT

Since writing the above letter I have received from Judge Lovett, president of the Union Pacific R.R., his paper on railroad reconstruction, of which no doubt you also have a copy. Judge Lovett's good judgment and eminence in the railroad world are so well known that any views from him on railroad affairs command deservedly the highest consideration and respect.

I do not agree with him that Government ownership is beyond discussion and that the public does not want it. I fear and can see the probable evils of Government ownership as well as anyone who wishes for the railroads the highest possible development. Many of his thoughts are excellent, and I see no difficulty in combining them with my plan.

But what the public in the United States wants, the public itself does not as yet know. The question is: To whose arguments and pressure will it yield? Those of labor or those of capital? I am inclined to think that the masses, rightly or wrongly, will go over to the views of the labor leaders. Such has been the tendency for many years, and it has become intensified by the war.

Because having this feeling, I have written you as above and as briefly as the weighty matter permitted. I believe it points to a solution that is just to every interest.

Curve Chart for Railway Resurvey

BY J. G. WETHERELL

Assistant Engineer, Chicago, Milwaukee & St. Paul Railroad, Chicago

A GRAPH or chart for quickly determining the degree of a curve when the intersection angle and the external are given was devised last winter by the writer for use in the resurvey of the Dubuque division of the Chicago, Milwaukee & St. Paul R.R. This chart, shown in the accompanying drawing, is plotted on standard cross-section paper. The externals are plotted vertically to a scale of 2 in. = 1 ft., making each small division represent 0.05 ft. The intersection angles are plotted horizontally to a scale of 3 in. = one degree, making each small division represent two minutes.

Curves were plotted as shown, extending to 7 ft. for the externals and to 9° for the angles. As a rule, this range covered the requirements, as curves with intersection angles of over 9° could seldom be intersected.

For any angle and external within these limits it is very easy to pick off the corresponding degree, interpolating if necessary between the plotted curves. Charts can be made considerably larger if larger sizes are desired.

On this resurvey work the alignment party consisted of an instrument man, a rodman and two chainmen, all of whom were fast workers. The best day's work in the field was 27 curves, 19 of which were intersected and eight traversed. The Dubuque division follows the west bank of the Mississippi River for 150 miles and is very crooked, on account of the steep bluffs and the course of the river.

Most of the curves, however, are sufficiently flat to allow their tangents to be intersected and their externals measured.

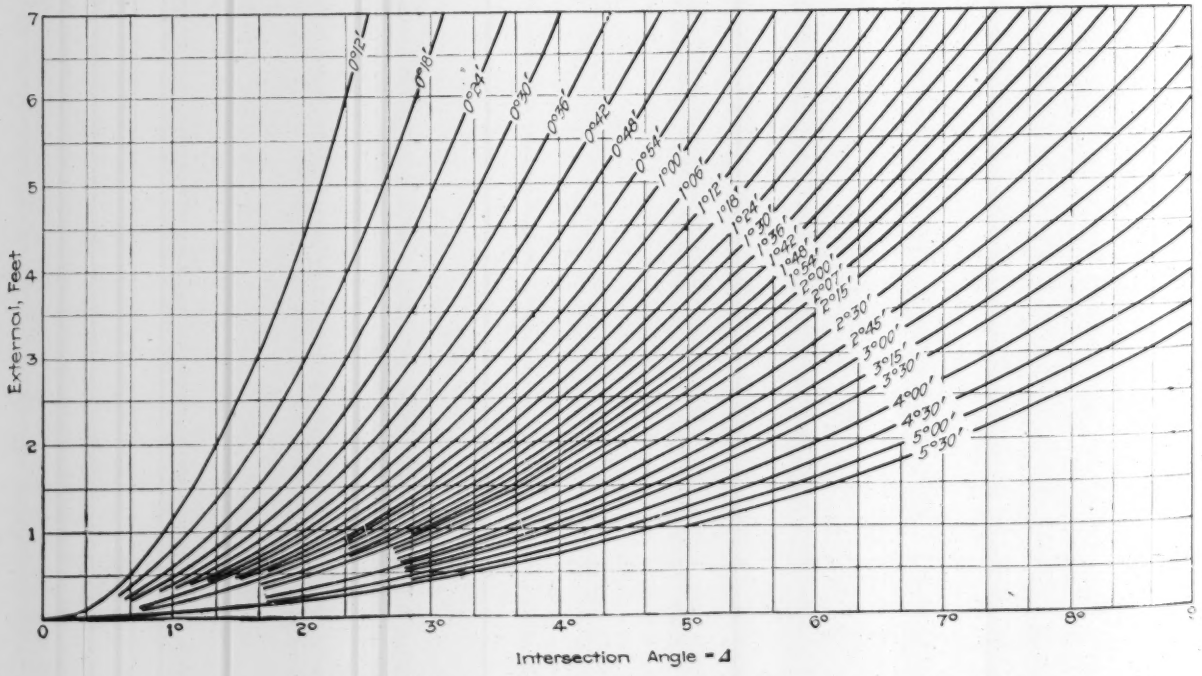


CHART SHOWS DEGREE OF CURVE HAVING GIVEN ANGLE AND EXTERNAL.

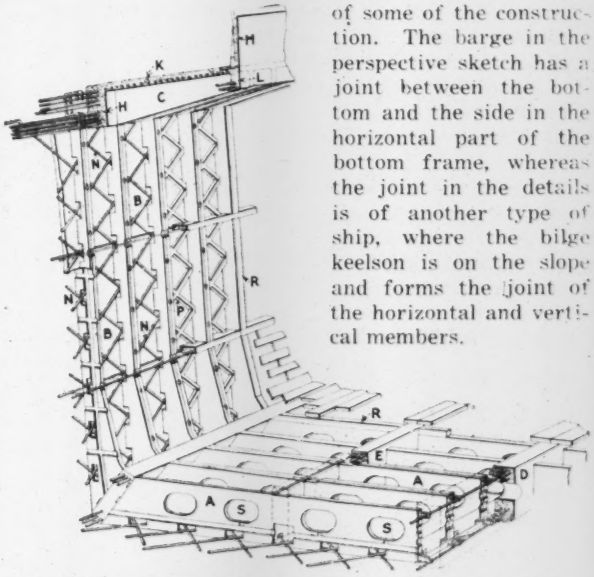
Precast Members Used for British Concrete Barges

Main Transverse Pieces of Trough Shape Forming Cross-Frames and Shell—Longitudinal Members Cast in Place

UNIT construction has been applied extensively to concrete ships in Great Britain, but statements have been made that more concrete ships of this type have been built there than of the cast-in-place type common in American practice, although the British ships are nowhere near as large as the largest of the American vessels. One of the most generally used systems is that originated by Harry C. Ritchie and adopted by a number of companies, most of which are building barges.

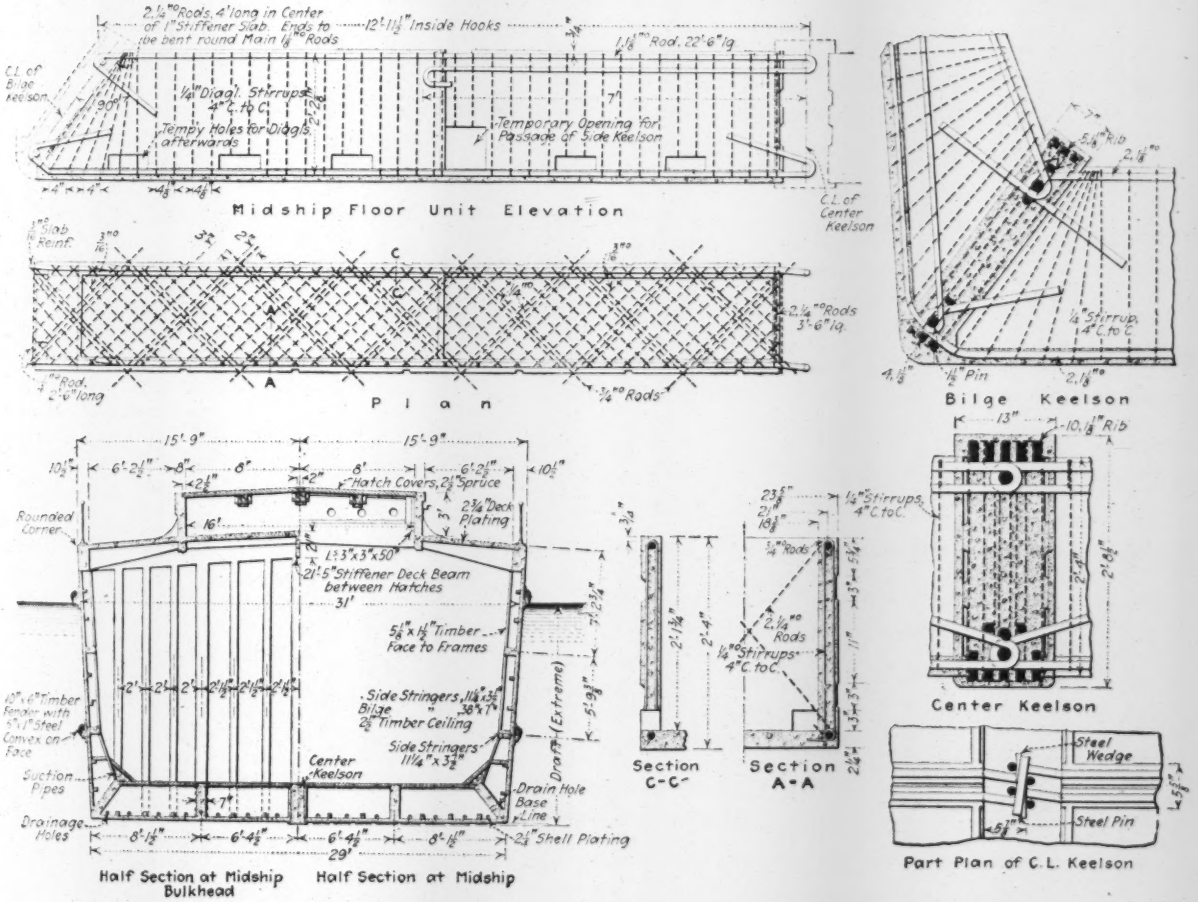
In the Ritchie system, which is described in London *Engineering* for June 27, 1919, the main transverse members are of trough-shape section and the longitudinals are cast in place. In this trough shape the upstanding legs form the cross-frames and the bottom plates the shell of the vessel. A further innovation is the leaving of openings at the bottom of the upstanding legs of the trough, through which are run, after the frames are placed, diagonal rods to form the reinforcement for concrete cross-bracing poured in place.

One of the accompanying drawings shows a perspective of a typical barge and the others the details of some of the construction. The barge in the perspective sketch has a joint between the bottom and the side in the horizontal part of the bottom frame, whereas the joint in the details is of another type of ship, where the bilge keelson is on the slope and forms the joint of the horizontal and vertical members.



PERSPECTIVE SHOWING PRECAST CONCRETE SHIP

The concrete frame units are shown in detail in this particular barge, which is of 1000-ton capacity. The troughs are in four lengths, two on each side and two in the bottom. One of the bottom units is shown in detail. It consists of the trough-shaped member



DETAILS OF SOME MEMBERS OF A PRECAST CONCRETE BARGE OF 1000-TON CAPACITY

about 13 ft. long, with 2½-in. walls and bottom, reinforced with longitudinal ¾-in. rods at the corners and with $\frac{3}{16}$-in. diagonal bars in the bottom and ¼-in. vertical stirrups in the sides. At either end the main reinforcing rods are set over in loops, reëntering the concrete, to permit the joining of adjacent frames. The sides and ends of each member, furthermore, are jogged as shown to insure better bond with the adjacent member. Temporary holes are left in the bottom of the sides of the trough, through which the diagonal reinforcing bars of the bottom and side are placed, wire stirrups protruding from the bottom to locate these rods and hold them in place.

The detail of the joint is illustrated by the bilge keelson section and by the center keelson section herewith. The protruding loops of the main reinforcement are placed in line and connected with a short steel pin wedged in, as shown in the plan of the center keelson. The forms are then placed and the longitudinal is poured, bonding the precast member in the jogs provided.

In construction, the bottom units are placed first in position, and the abutting flanges filled with cement grout in the joints provided. The units for the sides of the hull are similarly formed and jointed together. Each bottom unit extends from the bilge to the center keelson, so the two units make up the full span of the bottom. The side units extend from the bilge to the sheer strake, above which are the deck beam units of rectangular section, poured in place. The diagonal rods are then placed and the concrete diagonals poured. By this system that part of the shell of the boat which is exposed to water can always be cast bottom up and finished smooth and tight. It is stated that those vessels already in service have proved tight and seaworthy.

"Compression" Wood and Failure of Factory Roof-Beam

Cause of Sag in Roof Found To Be Yellow-Pine Beam With Wood of Peculiar, Abnormal Growth and Wide Annual Rings

By G. E. Heck

Engineer in Forest Products, Forest Products Laboratory, United States Forest Service, Madison, Wis.

INVESTIGATION of sag in the roof of the dry house of the American Car & Foundry Co., Jeffersonville, Ind., revealed a beam which had failed because of the presence of "compression" wood. An examination was made by the Forest Products Laboratory of the United States Forest Service, Madison, Wis., and the results are given in this article. Instances of "compression" wood are somewhat unusual, and this particular case of a Southern yellow-pine beam gave special opportunity for study.

"Compression" Wood—The term "compression" is one that is applied to wood of peculiar abnormal growth which is considerably heavier than normal wood and has much wider annual rings. Figs. 1 and 2 illustrate clearly the variation in timber in which "compression" wood exists. "Compression" wood may be distinguished by the lack of contrast between the spring and summer wood and its relatively darker color. The cause of this abnormal growth is not clearly understood. One theory is that it is caused by leaning of the tree during growth, the "compression" wood being formed on the lower or leaning side. (See article on gyrating tree in the *Literary Digest* of July 26, 1918.)

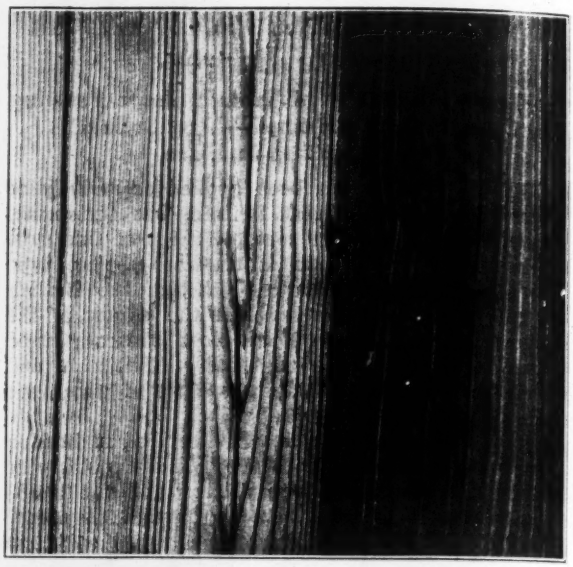


FIG. 1. CROSS-BREAKS FROM SHRINKAGE OF "COMPRESSION" WOOD

The "compression" wood in this particular beam showed numerous cross-breaks which extended from the middle of the beam to the top. The beam had been in the company's yard for some time before installation and was probably not thoroughly air-dried. When removed from the dry house the beam was 5 x 11 in. x 20 ft. in size, Fig. 3. A 12-ft. section, shipped to the Forest Products Laboratory, was found to have a sag of about 3 in. at the center. Nearly all of the upper half of the beam was "compression" wood.

Results of Tests—Mechanical tests were made on specimens cut from both "compression" wood and normal wood, to determine the difference in the mechanical properties of the two. The number of clear specimens tested was necessarily quite limited, on account of the numerous cross-breaks in the beam. Static bending test specimens were 2 x 2 x 30 in. in size. The specimens for compression parallel to the grain were 2 x 2 x 6 in. Tests were made in accordance with the standard practice for such tests, as outlined

FIG. 2. CROSS-SECTION SHOWS NORMAL AND "COMPRESSION" WOOD

in Circular No. 38 of the United States Forest Service. Longitudinal, tangential and radial shrinkage specimens, 1 x 1 x 4 in. in size, were cut from both the center and end of the beam. The shrinkage from green to oven-dry condition was approximated by soaking

and then oven-drying the specimens, and measuring the shrinkage.

Table I is a summary of the shrinkage determinations from the center end of the original 20-ft. beam.

TABLE I—SHRINKAGE DETERMINATIONS

	Mid-section Per Cent.	End-section Per Cent.
"Compression" Wood		
Radial	2.15	4.60
Tangential	2.61	6.65
Longitudinal	2.46	0.91
Normal Wood		
Radial	4.63	3.23
Tangential	5.23	5.73
Longitudinal	0.41	0.62

The results of the mechanical tests are given in Table II. It will be noted that all the specimens from "compression" wood tested in static bending were brash, as shown in Fig. 4, while none of those taken from normal wood showed this characteristic. It will also be noted that the "compression" wood was low in all the strength properties measured, with the exception of compression parallel to the grain. The specific gravity of the "compression" wood was considerably higher than that of wood of normal characteristics. This has been found to be the case with all material of this character that the Forest Products Laboratory has examined.

TABLE II. COMPARISON OF AVERAGE RESULTS OF MECHANICAL TESTS OF NORMAL AND "COMPRESSION" WOOD

	Normal Wood	"Compression" Wood	Ratio "Compression" to Normal Wood
Static Bending			
Number of tests	11.00	5	....
Specific gravity (oven-dry wt. and vol.)	0.57	0.66	1.16
Moisture, per cent	11.60	12.40	....
Stress at elastic limit, lb. per square inch.	8,550	6,520	0.76
Modulus of rupture, lb. per square inch.	11,730	9,000	0.77
Modulus of elasticity, lb. per square inch.	1,495,000	994,000	0.66
Work to maximum load, in.-lb. per cubic inch	8.20	5.50	0.67
Deflection at maximum load, inches	0.67	0.62	0.93
Compression Parallel to Grain			
Number of tests	10.00	9	....
Specific gravity (oven-dry wt. and vol.)	0.55	0.68	1.24
Moisture, per cent	11.70	10.80	....
Maximum crushing strength, lb. per square inch	7,370	8,100	1.10

Discussion of Results and Conclusions—The longitudinal shrinkage of the "compression" wood was about six times that of the normal wood at the mid-section. At the end-section the shrinkage of the "compression" wood was about 1½ times that of the normal wood. The difference between the radial and tangential shrinkage of the "compression" wood at the end-section more nearly approaches that of normal wood. The greater longitudinal shrinkage of the "compression" wood over that of the normal wood indicates very strongly that this was the primary cause of the large deflection of the beam at the time of removal from the dry house. In the shrinking process, internal stresses were set up which were so large in comparison with any existing in the adjacent normal wood that failures in tension occurred which relieved the internal stresses and formed the breaks across the grain in the "compression" wood.

After these cross-breaks had opened up, most of the upper portion of the beam, composed principally of "compression" wood, became a dead load on the lower half of the beam, the latter being left to carry the roof load as well as the dead load of the beam. The effective depth was also reduced approximately one-half by the failure of the upper half. The greater shrinkage at the mid-section probably accounts for the fact that the cross-breaks in the middle third of the beam were more numerous and closer together than were those nearer the ends, as shown in Fig. 3.

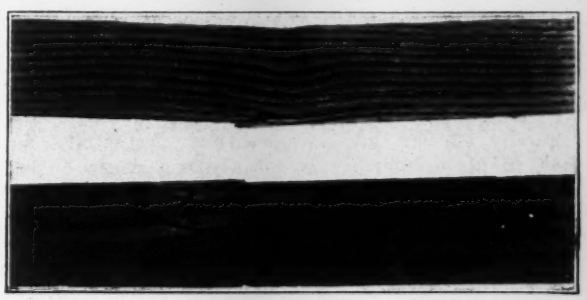


FIG. 4. FAILURES OF SMALL BEAMS; UPPER, "COMPRESSION" WOOD; LOWER, NORMAL WOOD

It should, of course, be recognized that "compression" wood from different trees may have entirely different properties, depending on such factors as conditions of growth and the amount of wood of this character present. Consequently, all timbers containing "compression" wood may not act the same as the one examined. However, timber containing this defect is not to be recommended for use where strength or ability to stay in place is essential.

Timber containing "compression" wood can readily be eliminated by adhering strictly to the specifications for the selection of dense Southern yellow-pine timber, and rejecting material having very wide rings and showing little or no contrast between the spring and the summer wood.

FIG. 3. CROSS-BREAKS IN "COMPRESSION" WOOD OF YELLOW-PINE BEAM

Sewage-Disposal Difficulties at Madison, Wisconsin

Sludge Handling Improved by Hoppers and New Pipe Connections for Flat-Bottom Tanks—History of Plant

MINOR troubles in operating the sewage-disposal plant at Madison, Wis., have followed departures from the original design and have resulted in local opinion charging the plant with inefficient operation and with the pollution of Lake Monona by its effluent, although the laboratory records indicate that the plant is efficient and is not proved to be the cause of odors attributed to such pollution.

This problem is discussed in a report made in June, 1919, by John W. Alvord, consulting engineer, Chicago. On the basis of complaints of the lake odors in 1918, an investigation was made by W. G. Kirchoffer, consulting engineer for the State Board of Health, who reported that the effluent of the sewage-disposal plant was a possible source of pollution and recommended certain changes at the plant. The city then called in Mr. Alvord, who reports that the plant appears to be generally efficient and is operating successfully, and that, in his opinion, it is not a direct cause of lake pollution or odors, but that there are marked odors caused by the present method of sludge disposal by lagooning. He approves of the changes suggested by Mr. Kirchoffer, which will eliminate some of the difficulties in operation and which will make the plant conform to the original recommendations made by Mr. Alvord prior to its construction. As to the chemical efficiency of the plant Mr. Alvord's report states:

"The plant is, generally speaking, in excellent condition, and continuous laboratory tests of the effluent show that it is doing nearly all the work which it was originally intended to do and, with some slight changes for ease in operation, will be one of the notably effective plants in this country in dealing with the sewage of so large a population as that of Madison. I know of no plant of its size in this country which will be found, even now, to be much more satisfactory in its working."

The relation of the plant to the odors from pollution of the lake was dealt with in *Engineering News-Record* of Sept. 4, 1919, page 469. As there stated, the city has engaged the firm of Alvord & Burdick, consulting engineers, to investigate these odors thoroughly.

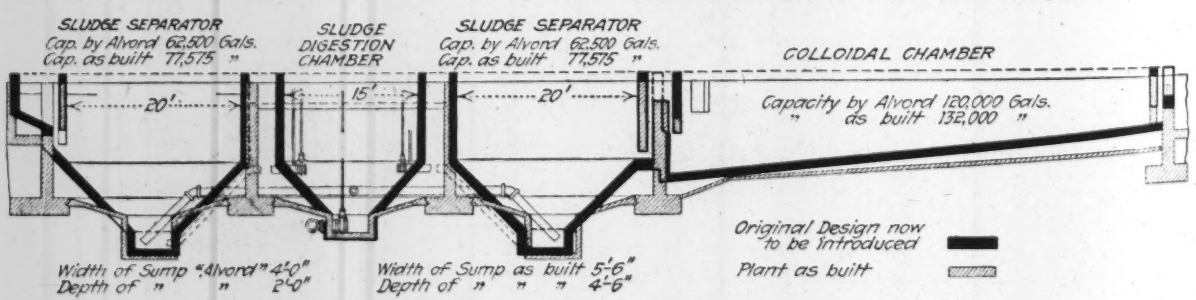
The Madison sewage-disposal plant was designed for a capacity of 5,000,000 gal. of sewage per day, or a population of about 35,000 or 40,000 to be reached in 1930. Its sedimentation tanks were put in service in 1914 and the percolating filter in 1916. Except for some complaints as to odors, no dissatisfaction with the plant was expressed until 1918. There are two rows of sludge-settling tanks with digesting tanks between them. Next come the colloidal chambers, and then the contact dosing chamber, which has a 6-ft. bed of 2- to 3-in. stone. The overflow passes to the siphon chamber of a percolating filter which has a 6-ft. bed of ¾- to 3-in. stone. From this the effluent is discharged into a narrow and shallow moat leading to an outfall sewer which discharges into the Yahara River just above its entrance into the lake.

It is the sludge-handling system necessitated by the present tanks, which are not of hopper shape, that appears to cause the most trouble, as both engineers agree. Other changes from Mr. Alvord's original design, which are noted by Mr. Kirchoffer, are the dosing apparatus, the use of three instead of five filter beds, and the substitution of the moat for a larger and deeper sedimentation basin surrounding the filter. The present method of handling sludge is not that intended by Mr. Alvord in his recommendations made before the plant was built, and he agrees with Mr. Kirchoffer that certain changes should be made to correct the present difficulty and to enable the plant to be operated according to the original intent.

Changes Made in Design

Departures from the design were introduced during construction, largely on account of trouble with deep excavation for tanks in wet soil. In the plan as recommended by Mr. Alvord in 1913 the settling tanks and sludge tanks were to have hopper-shaped bottoms with a slope of 45° ending in a small, shallow sump. As built, the bottom is almost flat and has a large, deep sump. This difference is shown in the accompanying drawing. The present shape prevents complete and frequent removal of the sludge from the separation tanks, with the result that there is a stale accumulation. The sludge pipes were to extend from below the bottom of the settling tank to mid-height of the sludge tank, but as built they lead from above the bottom of the former into the bottom of the latter. Furthermore, the outlets from the colloidal tanks are only 2 ft. above the bottom instead of being 2 ft. below the surface. Mr. Alvord's report states:

"In two instances, at least, the changes have resulted in operating difficulties, particularly in withdrawing the sludge from the separating tanks into the sludge-digestion chamber and keeping the sludge in this chamber at proper level. To overcome these difficulties, the operator has been compelled to withdraw more sludge and disturb the digestive operation more frequently than is really necessary, and liquid sewage as well as sludge has been lagooned on the adjacent land until, about 1918, the land could no longer receive it. Since that time it has developed odors which



SEWAGE SLUDGE TANKS AS PLANNED AND AS BUILT

are objectionable and which have impaired popular confidence in the plant. These difficulties should be corrected promptly. This will result in much less sludge being removed, and only that which is inert and inoffensive. There are already constructed at the plant four small sludge beds which it is believed from experience with the plant at Great Lakes, Ill., will be amply sufficient to take care of the sludge residue, properly handled."

Certain changes are considered vital to proper operation. In the first place, to improve the operation it is recommended that the tanks be provided with hopper bottoms, built inside of the present tanks, so that suspended matter can be removed from the separating chamber without manual labor. In the second place, the pipe connections should be changed so that by the operation of certain valves the sludge can be pumped from any separating chamber to any sludge-digestion chamber. These pipe changes also should provide for draining off the water standing between the top scum and the bottom sludge in the digestion chambers and passing it back into the initial separating chambers, so that the former will be at so low a level as to receive easily sludge or scum from the latter. Another suggestion is the placing of a roof over the sedimentation tanks to confine the inevitable "slight, musty odors" and to prevent cold winds from reducing the temperature of the sewage and thus reducing the activity of bacterial action. These changes should be made at once. Their cost has been estimated by Mr. Alvord and Mr. Parker, city engineer, at about $15,500.

History of Sewage Treatment at Madison

Since the plant in question is the third which Madison has had in 20 years, it may be useful to put on record a summary of the rather varied history of sewage disposal at that city. When the sewerage system was planned in 1886, with discharge into Lakes Mendota and Monona, treatment by chemical precipitation was recommended by Samuel Gray, the consulting engineer. In 1893 McClellan Dodge, city engineer, and other local engineers, were invited by the city to submit plans for diverting the sewage from the lakes and treating it by the above process. In 1894 George E. Waring, consulting engineer, recommended treatment by broad irrigation. In 1895 the city council adopted a plan for chemical precipitation and sand filtration of the effluent, as submitted by Mr. Dodge and Mr. Nader, but nothing was done toward carrying it into effect. In 1897, a committee appointed by the council and including Prof. F. E. Turneaure, of the engineering department of the University of Wisconsin, reported in favor of a filtration plant at a cost of $55,000 to $60,000, as noted in *Engineering News* of Sept. 2, 1897, p. 149.

A proposition for a plant operating on the patented International process was submitted in 1898 by the American Sanitary Engineering Co., which owned the patent rights for the United States. Although this process had not been applied in this country, the city adopted the plan, but required that the effluent should be equal in quality to the water of Lake Mendota. It also appears to have insisted on supplying the machinery equipment, which action led to future controversy as to responsibility for defective operation. The plant was in continuous operation in June, 1899, and was described fully in *Engineering News* of Dec. 28, 1899, p. 411. Lime (instead of ferrozone as intended) was used for the precipitant, and polarite for part of the filtering material. The company could not meet the requirement as to effluent, and after complaints as to cost and defects of operation the plant was abandoned Jan. 12, 1900, without notice to the city. On the same day Mr. Dodge and Mr. Nader, as engineers for the city, reported that defects had not been remedied as ordered. The city then adopted a resolution to the effect that the plant was not satisfactory and had not been built and operated according to the terms of the contract, but it took over the operation to prevent serious consequence. This chapter ended with abandonment of the plant by the city in January, 1902, and a suit against the company for $25,000, which the city recovered after years of litigation.

During the period of controversy, in 1900, Professor Turneaure, who had been made city engineer, advised that the plant should not be accepted and that it should be remodeled to comprise septic tanks and filter beds. This procedure was not followed, but plans submitted by him for a new plant were adopted in January, 1901, and the plant was completed late in that year. It included two septic tanks, an intermediate receiving chamber and then a set of cinder filter beds, as described in *Engineering News* of Oct. 17, 1901, p. 286.

Third Plant on Larger Scale

The capacity of this 1901 plant, however, was reached in 1903, while in 1911 it was handling twice the quantity of sewage for which it was designed, according to an article in *Engineering News* of Feb. 15, 1912, p. 289. The site was too small to permit of enlarging the plant, and as the city was being built up around it there were complaints of odors. A new plant was decided upon, therefore, in 1912, to be located in the northeastern part of the city and discharge the effluent into Lake Monona. The new force main and intercepting sewers in connection with the plant were described in *Engineering News* of April 13, 1916, p. 694.

This third plant was designed originally by John F. Icke, then city engineer, and was similar to the second plant but on a larger scale and without the intermediate receiving chamber. The septic tank was to have five compartments, with a combined capacity of 2,000,000 gal. and the filter beds were to cover an area of nearly three acres. In 1912 E. E. Parker became city engineer and in 1913 he invited John W. Alvord, consulting engineer, Chicago, to examine and report on the plans. Mr. Alvord's report was made in May, 1913, and recommended several important changes. Some of these were not carried out, however, largely on account of construction difficulties, as noted above, but it is now recommended that changes be introduced.

In order to carry out the recommendations of Mr. Alvord and Mr. Kirchoffer, an ordinance is being prepared to authorize the issue of $20,000 in bonds for these alterations to the plant. These will include rebuilding the sludge and digesting tanks with hopper bottoms; rearranging the pipe system so that only inert sludge will be deposited on the sludge beds and the deposit of sludge on the surrounding marsh land will be unnecessary; constructing a well to collect the septic liquor from the sludge; installing an electrically operated sludge pump, and building a roof over the settling tanks. It has been decided also, as noted above, to have thorough investigation made into the cause of the odors from Lake Monona.

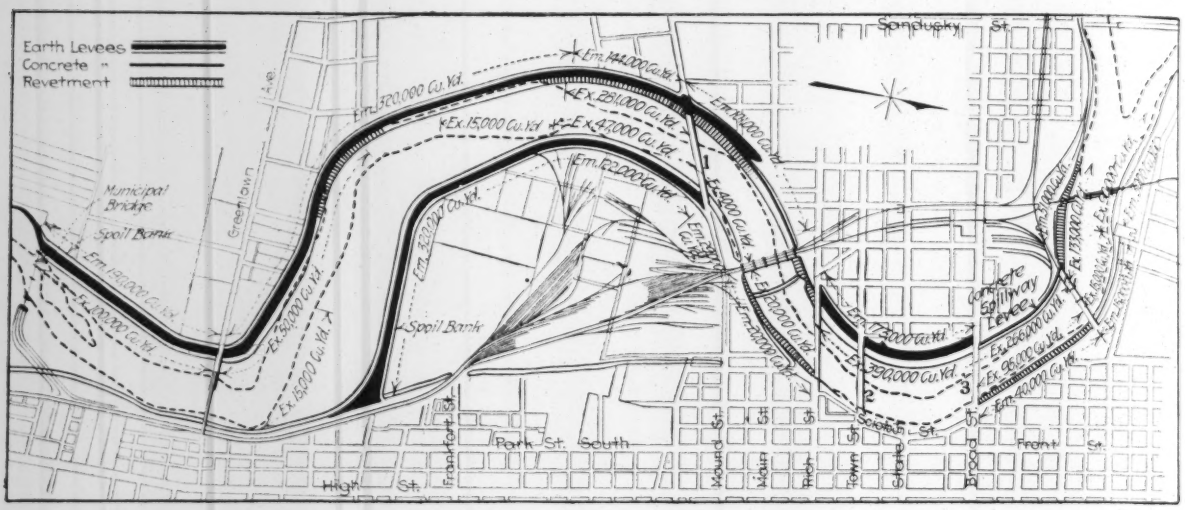
Widened Channel Reduces Flood Hazard at Columbus

Scioto River Set Between Earth Levees 580 Feet Apart — Over 200 Structures Wrecked for New $3,500,000 Floodway

FLOOD protection for Columbus, Ohio, was planned to fit an appropriation of $3,500,000. Channel widening and rectification and bridge construction were all that the sum permitted. Full safety from such maximum floods as of March, 1913, will not be secured. That flood measured 140,000 cu.ft. per second. The safe capacity of the planned channel is 100,000 sec.-ft. and the ultimate or calamity capacity is 125,000 sec.-ft. Very great and rare floods exceeding 125,000 sec.-ft. will escape from the channel. From all smaller floods the city will be fully protected. To reduce damage from overflow when it becomes inevitable, a spillway levee wall will deflect some 10,000 sec.-ft. to a path which endangers a minimum of property and life.

This flood protection work now in progress is wholly a city enterprise, except as it involves participation, by agreement, of the county and of certain railways, in the nature of bridge extensions to accommodate the widened river. Other plans involving a conservancy district organization and a comprehensive scheme of flood protection for the Scioto River valley had received prior consideration, and the development of these plans to failure has been reported in *Engineering News* of Sept. 25, 1913, p. 631; Mar. 16, 1916, p. 490; Nov. 30, 1916, p. 1055; Jan. 4, 1917, p. 39, and Feb. 1, 1917, p. 205. Definite action on the present plan was taken by the Columbus City Council early in 1917 following a popular vote at the November, 1916, elections in favor of a $3,500,000 bond issue. Engineering studies were ordered by the council and one of these, outlining plans estimated to cost slightly under the amount of the bond issue, was adopted as a working scheme and the city's engineers were instructed to complete the plans and proceed with construction. Contracts were awarded late in 1917 and early in 1918. As a city enterprise the work is being directed by the Department of Public Service, Henry Maetzel, chief engineer, and R. H. Simpson, the engineer in charge of channel improvements.

At Columbus, the Scioto River takes a tortuous channel from north to south. The problem was to make the largest capacity flood channel of this crooked stream which could be created for $3,500,000, including land damages and all changes of existing structures. The preliminary studies had indicated that for the sum aavilable a minimum channel 580 ft. wide could be constructed by excavation and levees from the confluence of the two rivers at the north to a point a little south of the Mound St. bridge, and that south of this point ample floodway could be secured by a moderate amount of excavation and by levee construction and enlargement. In this floodway, excavation is to be carried to the depth of the bed of the old channel except on the west side between Broad and Rich Sts., where a bench averaging 150 ft. in width will be left from 2 to 3 ft. above normal low water.



WIDENED AND RECTIFIED RIVER CHANNEL PROVIDES FLOODWAY AT COLUMBUS

Protection from maximum recorded flood is not provided by the channel planned. Assuming a roughness coefficient of 0.035 and slopes of 0.0045 to 0.0005 this channel is computed to have a safe capacity of 100,000 sec.-ft. and a capacity at the calamity point of 125,000 sec.-ft. The record of the March, 1913, flood at Columbus was 140,000 sec.-ft. In case of large floods overflow is inevitable. As a partial safety measure against this overflow up to 10,000 sec.-ft. beyond the channel capacity, a spillway levee wall is provided on the west side of the channel just north of Broad St. With the channel improved as planned, the lands along the Olentangy River will be flooded about as they have been in the past. When the flood reaches 125,000 sec.-ft. damage will result to the property on the east bank between Broad St. and Rich St. Overflow up to 10,000 sec.-ft. beyond 125,000 sec.-ft. will flood the section of the city south and west of the spillway levee. High floods may also produce damaging velocities which will necessitate channel repairs after each occurrence of such occasional floods. Floods exceeding the diversion capacity of the spillway will take their course as in the past. The plan, however, permits deepening the channel so as to increase the capacity some 20,000 sec.-ft. without further widening.

Construction of the widened channel, besides exca-

cation and levee building, is largely bridge construction. New reinforced-concrete arch bridges are being built at Town St., Broad St. and Mound St., and various other bridges are being extended two or more spans to embrace the widened channel. Bridge-construction methods are subjects for separate consideration. Channel construction involved wrecking and clearing, excavation and levee building, concrete spillway, retaining wall and weir, and concrete revetment.

Two Hundred Buildings Razed

Land damages are a very large proportion of the cost of the channel widening. On the west side the new channel between, say, Broad St. and Rich St., cuts into a closely built-up territory. Altogether, but mostly within the limits just named, about 250 parcels of land have been purchased and some 200 buildings ranging in size from one-story cottages to four-story brick factories have been wrecked. The wrecking contract netted the city a fair sum. Besides $20,000 paid by the wrecking contractor for the privilege of wrecking and salvage, the city reserved a considerable volume of lumber from the old buildings for temporary bridge and other construction uses. Land clearing is substantially completed.

Excavation is chiefly on the west side of the river, as is indicated by the map, which gives for the full length of channel the approximate volumes of excavation and of adjacent levee embankment. The large volume of excavation made heavy levees practicable and all are built with a top width of 80 ft. to provide for a future boulevard. North of Mound St., the volume of excavation exceeded the volume of embankment, while south of Mound St. the reverse was the condition. To build the southern levees, therefore, a fairly long haul from the northerly channel cuts was necessary. A standard-gage track along the fill meets the requirements. Dump-car trains are loaded by a dragline excavator and are run to the fill and dumped in the manner usual in railway work.

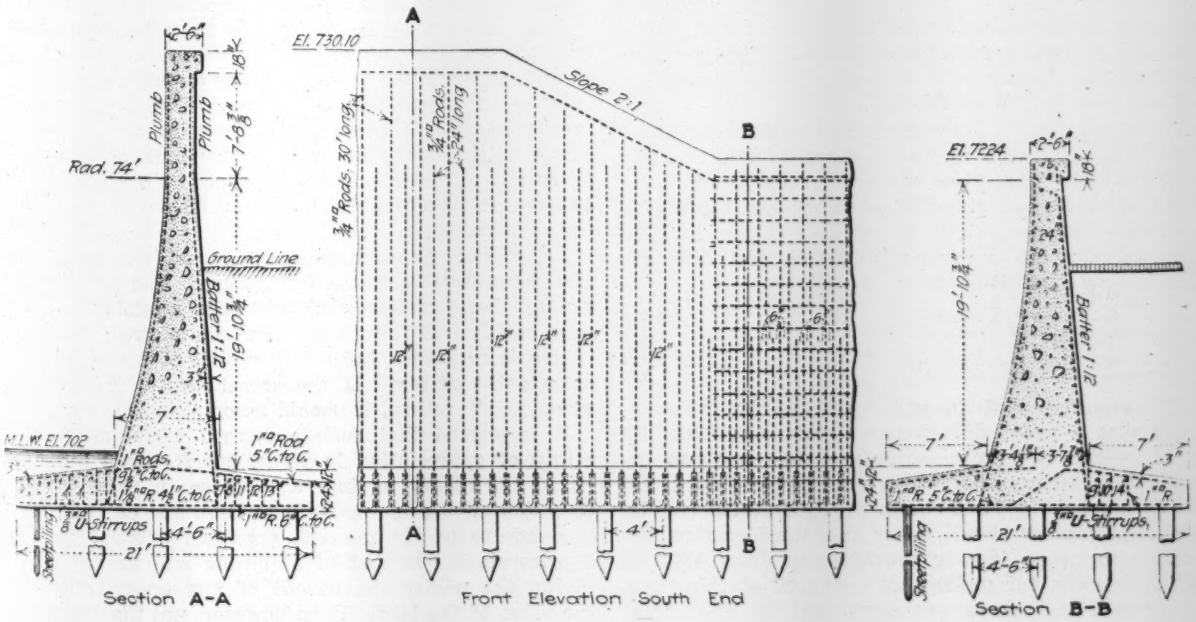
Where the excavation is handled directly to adjacent embankment, steam shovels are loading into wagons. In one place a cableway drag bucket is taking out cut and dumping directly into fill. The dragline excavator will also at places handle material directly from cut to embankment.

Concrete construction is made up chiefly of the levee spillway wall, which is 1200 ft. long and from 25 ft. to 33 ft. high; of a shorter retaining wall, of similar section to the levee spillway wall, running some 700 ft. north from the Hocking Valley R.R. bridge; of a concrete weir across the river at about the same point; of several stretches of concrete revetment, and of short retaining walls at various points.

All the concrete structures are of simple design. The weir has a solid ogee section with its crest about 12 ft. above the river bed. It is designed to pool the water, chiefly for sanitary reasons. Revetment is a 4-in. reinforced-concrete slab held by a curb at the top of the levee and by a toe wall at the bottom. Of the retaining walls the most important is that of the levee spillway, which is shown by the drawings. This wall was designed for full hydraulic pressure on either side alone. Construction methods are subjects for succeeding articles.

Volumes of work are somewhat elastic, since money saved in securing real estate will be expended to increase the excavation and any savings which are realized in other ways will be similarly converted. Broadly, there are about 2,000,000 cu.yd. of excavation, not including between 100,000 and 200,000 cu.yd. of miscellaneous excavation of old structures. Of mass concrete in bridges and walls there are some 34,000 cu.yd. besides 72,000 sq.yd. of revetment and 9800 ft. of toe wall.

The general contractor for the excavation and levee is the W. E. Callahan Construction Co., Omaha, Neb. Contracts for the concrete work have been widely distributed. Construction is progressing actively on all portions of the improvements.



SPILLWAY LEVEE IMPORTANT FEATURE OF COLUMBUS FLOOD PROTECTION

Unit Costs for Use in Public Utility Appraisals

Recent High Prices Increase Differences in Valuation Already so Divergent as To Confuse Courts—Effect of Choice of Periods if Average Prices Are Used Is Important

By R. L. Baldwin
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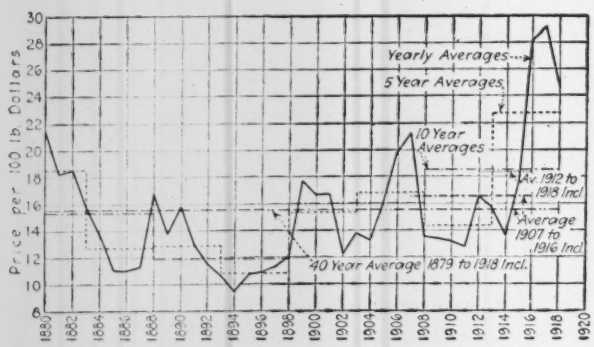
THE recent steady advance in the costs of labor and materials is unprecedented within the period since the adoption of modern methods of making public-utility appraisals. This has caused a wide difference in the values arrived at by various appraisers, who have used different bases for arriving at their unit costs. Such results confuse courts or commissions, and are not helpful in a settlement. Much criticism of the engineering profession has been aroused by the fact that different appraisers, having the same inventories, arrive at such different values.

The custom of most appraisers prior to 1916 was to use prices based upon a five-year average for the period preceding the date of the appraisal, but often prices as of the date of the appraisal were used. Averages


Price per 100 lb Dollars
Yearly Averages
5 Year Averages
10 Year Averages
Av. 1912 to 1918 Incl
Average 1907 to 1916 Incl
40 Year Average 1879 to 1918 Incl.

LAKE COPPER PRICE VARIATIONS BY YEARS AND BY AVERAGES FOR VARIOUS PERIODS

were generally used for items of property which were being continually added to, such as pipe and pole lines and other elements of distribution systems. Present prices or quotations were used for items of equipment. This method gave reasonable results, because there was no wide fluctuation in prices, and the custom or method became well established.

The application of average prices, based upon a short period of years even up to 10 years, if they include the past two years, gives abnormal results, and it is this that causes the wide difference between appraisals. A study of copper prices, taking lake copper in New York, shows the following averages for different periods (see illustration):

5-year average, 1914 to 1918, inclusive	$0.227
10-year average, 1909 to 1918, inclusive	.185
40-year average, 1879 to 1918, inclusive	.156
5-year average, 1912 to 1916, inclusive	.183
10-year average, 1907 to 1916, inclusive	.165

It is apparent that the period selected for the average makes a great difference—in this case from 20 to 45%—and the probabilities are that any two individuals selecting a period for such purpose would select different periods and obtain widely different results.

If an appraiser should, after due consideration, determine to use a 10-year average, say from 1907 to 1916, inclusive, for making an appraisal at this time, what would he do on the same appraisal five years from now? What is the test as to whether a unit cost is reasonable or unreasonable? Is not the actual cost, after all, the final test, if it can be ascertained?

The public service commissions of the various states are probably as directly interested in this question as the utilities whose rates they must regulate. These commissions not only maintain engineering departments for the purpose of making appraisals, but are constantly being confronted with all the various theories and practices of different appraisers, and for this reason their customs and practices should bear considerable weight in any study of this question. An investigation disclosed the following practices for 25 commissions from which data were received.

Thirteen commissions use or prefer unit costs based upon original costs. Eight commissions use unit costs based upon average prices for various selected periods, varying from three to 10 years, most of them excluding the war period. Four commissions could not be said to use or prefer either method.

The decisions of commissions as a whole seem to show a tendency toward the use of a value—for rate-making, at least—based upon original costs. This tendency has been vary evident in the past few years. This change has been brought about by the enormous advance in prices which rendered the old methods inadequate for use under present conditions.

It seems that some method of appraisal of value should be established that would not give a fluctuating value but that would give a stable value, one that the owners of the utility as well as the public served could depend upon. The property is constructed by the expenditure of money, usually derived from the sale of securities. These securities are often widely scattered and should be an attractive investment.

It would be greatly to the interest of all concerned if such securities could be owned by a large number of investors, and especially by those to whom the utility renders a service. A city or a state should take pride in a prosperous utility rendering efficient and excellent service. These utilities are often the largest single enterprise of the city or community, and the prosperity of the community is judged by outside cities, banks and investors from the condition of its local enterprises.

In order to maintain such conditions, it is necessary that the utility receive a fair return. The purpose of making the appraisal considered is to establish a value upon which this fair return shall be allowed. Such a return is necessary to attract capital to maintain and operate the utility. If the actual capital invested is given a fair return, it should accomplish this purpose.

It is argued that such a method would deprive a utility of appreciation in value, but it would likewise guard the utility against a decrease in value. This objection applies in the main to land, and on this item it seems to be the general, approved practice to use a price similar to that of adjoining and similar land, giving the utility the benefit of any appreciation in the value of the land. It is, however, not the intention to discuss this question in this paper.

Strict adherence to the common actual-cost method does not seem to be practicable, but the general method can be used in so far as it is useful. In following the reproduction theory, it has been necessary to depart from it and use a historically modified reproduction theory, and it is very probable that no hidebound theory can be recommended that would serve in all cases. Practically all utilities have some records of cost which may be readily obtained, especially for the past decade. Often utilities have changed owners, and the cost records, prior to the change of ownership, are not available.

A study can be made, however, of all the data available, and it can often be augmented by information obtained from old employees, especially as to the ages of equipment, dates of installation, etc.

Combination Method Employed by Many Commissions

The method actually employed at present by a large number of the commissions and appraisers is practically a combination of "reproduction cost with unit prices based upon average prices," and "actual cost from records." Using this method, actual costs of all the large items obtainable are used. Where the cost of large items is unknown, the age can generally be obtained with fair accuracy, and the estimate of cost can be based upon data as to prices at that time. If a large part of the property consists of pipe, rails, poles or wire and is being added to from year to year, the amount installed each year, either in material or dollars, can often be found, and from these data a unit approximating the average cost to the utility can be determined. The use of such a method eliminates the necessity for selecting some period to establish a unit price and removes the possibility of so wide a divergence in the final results as is often found; and after all, if an average must be taken, why is not one based upon such data more nearly correct than an average for some arbitrary period?

Those commissions which are now using unit costs based upon an average for a period of years preceding the war are allowing cost on extensions or additions which were made during the high-price period, and it is generally conceded to be fair treatment. This is probably the first step toward the adoption of the cost method. It has, however, been done for some time. Appraisals are often brought up to date by simply adding the cost of improvements, which certainly amounts to the adoption of the cost method for at least a portion of the property. If, therefore, it is a fair proposition for a part, why should it not be used as a general basis, thus eliminating one bone of contention that is continually arising whenever the value of a utility comes into question?

The present attitude of regulating commissions and their engineers is shown by the following quotations from correspondence or reports:

1. "The commission is principally interested, for all purposes, in actual cost, and where this is not shown by the records it is estimated as closely as possible."

2. "Our aim has been to find out as nearly as possible just what the legitimate and honest investment of the company has been, with a view to as complete recognition as possible of the actual conditions under which the particular property has been constructed."

3. "Our policy, with one exception, is upon the basis of original cost to date. This is determined where practicable from the records of the company; otherwise from prices applied to the inventoried quantities." The case excepted was because the state law made other provisions.

4. "It has been indicated several times in recent cases that actual cost, where it could be obtained, would be given the preference."

5. "Present methods of valuation are to ascertain as nearly as possible the original cost. The majority of commissions are in favor of a liberal valuation in so far as the actual cost of utilities was incurred under reasonably good judgment of planning and execution."

6. "Where there are available book costs that are capable of identification and verification, such costs are incorporated in the valuation."

7. "I am inclined to the opinion that where the law does not govern these matters, the weighted average unit prices obtainable from the company's vouchers are the most equitable that can be used."

8. "But what is a fair return? Is it not a return that will be sufficient to attract capital necessary to keep the utility prosperous? And if it is capital that is to be attracted, is it not a fact that it is the actual amount of capital invested that must be considered and allowed a fair return?"

9. "It seems to be recognized in the community that the actual investment is what is entitled to a return. I use as a basis, as near as may be ascertained, the actual cost of the properties to the utility."

10. "We are using actual costs, as far as practicable. When such costs cannot be obtained, we use average prices, depending upon the character of the material."

11. "The engineering staff of the ———— Commission, during the recent war period, has limited its valuations wholly to original-cost valuations."

12. "First take the actual cost, or estimated actual cost, of the larger units, such as buildings, turbines, boilers, etc., then for the minor items, for which it is impossible to obtain the actual cost, some average may be used which will approximate actual cost. The acid test of fairness and reasonableness of an evaluation depends upon actual cost of property now used and useful for the convenience of the public, and we resort in all cases to averages as a device for estimating approximately the actual cost."

13. "It is the policy of the engineering department of this commission to arrive at its unit costs from a study of the company's vouchers for labor and material covering the entire property in use."

It would appear from these quotations, taken as the methods followed by 13 of the foremost state commissions, scattered from coast to coast, that the commissions are almost uniformly basing their unit costs upon actual costs to the utility. The methods outlined may not give the strict actual cost, but give at least a close approximation thereto. This method does not give a value that may fluctuate each time an appraisal is made, nor does it leave the choice of unit prices to the personal selection of each appraiser who must select a period of years to arrive at an average price representing his opinion as to the correct units. It gives a stable value that is highly desirable both to the security holder and to the public which the utility serves. While it may deprive the utility of advances

in value, it in turn guarantees against declines in value. It also gives a utility an assurance at present that an investment made necessary to preserve service will be allowed at its cost when an appraisal is made. This is particularly important now, since a large amount of work is necessary, having been held up during the war period, and utilities in many cases hesitate to make improvements or extensions under the present high prices, not knowing how the courts or commissions will treat this investment.

Relation Between Water-Supply and Goiter

AN APPARENT connection between goiter and water-supply in various parts of the world is traced by Mayo Tolman, chief engineer, West Virginia State Department of Health, Charleston, W. Va., writing in the *American Journal of Public Health*, July, 1919.

Goiter, which manifests itself as an enlargement of the thyroid gland, shows high endemicity in Switzerland, parts of France, and in regions in every continent. In North America the main endemic centers are in parts of New Hampshire, New York, the Blue Ridge Mountains of Virginia, nearly all of West Virginia, the region about the Great Lakes, and Edmonton, Alberta. Recent studies by Mr. Tolman indicate that there are 12,000 cases in West Virginia, while in Broxton County a house-to-house survey showed 1148 cases, or 1 to every 20 inhabitants.

The cause of the disease is most generally attributed to the character of the drinking water. Efforts to connect the disease with various inorganic impurities in the waters of the region have not been successful, Mr. Tolman states. The relation seems to be with the geological ages of the rocks of the regions. "Apparently," Mr. Tolman says, "volcanic formations, the crystalline rocks of the Archaic period and all deposits laid down in fresh water are free from the goiter-producing characteristic." In the United States the greatest endemicity is found in paleozoic areas. In West Virginia water from the coal measures seems to cause the disease, while in the same valleys people taking water from higher in the mountains, above the coal measures, have less goiter as the elevation increases. Two paragraphs from the end of Mr. Tolman's paper may be quoted in conclusion:

> This association of goiter with certain geologic time would indicate that the disease is not caused by a living organism, but is due to some substance derived from marine animals in past time. What this substance is is not known, but experiments indicate that it is not retained by a Berkefeld and that its goiter-producing property is destroyed by heating to 70 deg. C. It is, of course, possible that goiter is a deficiency disease, that the marine animals of geologic time used up a certain substance in the water that is essential to animal economy. This theory is severely shaken, however, by the fact that heat evidently destroys the goiter-producing element, but nevertheless it should not be entirely abandoned at the present stage of our knowledge.
>
> Goiter presents phases that should be of interest to health offices in those areas in which it occurs, and it is to be hoped that the disease will be given more study in order that its cause may be definitely determined, for without accurate knowledge of the cause of a disease any measures to combat it may be hit-or-miss. There can be little doubt that the efficiency of a community is lowered by endemic goiter, and consequently the spread of the disease should be prevented.

Semi-Portal Dock Cranes at Boston Army Base Wharf

Four Hoists With 4-Ton Maximum Capacity Travel On Tracks Outside of Wharf Shed and Load Vessels in Dock

FREIGHT to and from ships lying alongside of the long wharf at the Boston Army supply base is to be handled by four large semi-portal bridge cranes traveling alongside the wharf shed. As described in *Engineering News-Record* of Sept. 19, 1918, p. 522, the Boston terminal includes a long eight-story warehouse separated by a wide street from the marginal two-story wharf house alongside the wharf where the ships dock. Between the wharf house and the water is a space 35 ft. wide with two standard-gage tracks on which freight cars are run in from main-line tracks. Spanning these tracks the handling cranes described here travel.

Each crane carries a lifting boom operated from a carriage, which in turn is mounted on a semi-portal bridge and arranged to rotate about a fixed axis. The bridge runs on two rails, one located near the face of the wharf and the other supported on brackets carried on the side of the wharf shed. The crane has four distinct motions: (1) Bridge travel along the wharf; (2) trolley slewing; (3) boom hoisting or luffing; (4) load hoisting. All of these motions are under the control of the operator located in the cab on the rotating carriages.

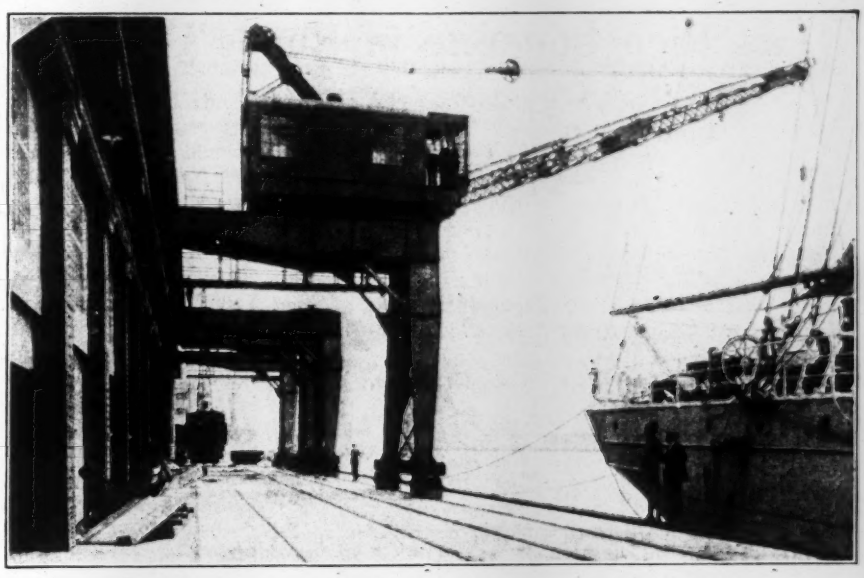
The crane is designed so that another drum can be added and a two-rope grab-bucket operated. It is rated to handle 8000 lb. at a distance of 29 ft. from the face of the capsill at the rate of 200 ft. per minute, and 5000 lb. at a distance of 52 ft. at 250 ft. per minute. It will, however, take care of occasional loads of 8000 lb. at 52 ft. from the center of rotation, without any undue stress in any part of the crane.

The principal dimensions of the crane are as follows: Horizontal span, c. to c. of runway rails, 25 ft. 5 in.; maximum reach of boom from face to capsill, 44 ft.; minimum radius of boom, 29 ft.; angle through which boom may be slewed equals 360 deg.; concrete counterweight required, about three cubic yards.

The various motions of the crane have approximately the following speeds under full load: Hoist, 5000 lb., 250 ft. per minute; 8000 lb., 200 ft. per minute; boom hoisting or luffing, 125 ft. per minute, and slewing, two rotations per minute with 5000 lb. load at a maximum radius. The rate of travel along the wharf is 200 ft. per minute. Either hoisting or luffing can be operated simultaneously with both rotating and traveling motions.

The semi-portal bridge supporting the operating mechanism was designed in accordance with the "General Specifications for Steel Railway Bridges" issued by the American Railway Engineering Association in 1910, 100% being added to all live loads to allow for impact. In designing this structure, ample allowance was made for the swaying of the load. To the deck of the semi-portal is bolted a steel casting for supporting the revolving superstructure. This casting has a track plate and, bolted to the outside, a circular rack for the slewing motion. Concentric with this casting is a hollow center pivot pin, the lower end of which is securely held by cross-framing between the main girders of the semi-portal.

The base frame is made up of rolled-steel shapes and plates well braced in all directions. The revolving superstructure is carried on six steel rollers or wheels, four in front where the heaviest load occurs, and two on the back. The front rollers are carried in a pair of steel equalizers. These rollers or wheels will be of steel of ample size arranged to rotate on roller bearings and placed so as to run properly on a circular track of about 5-ft. radius about a pivot pin. A babbitted casting free to rotate about the center pivot pin is attached to the base frame to hold the crane concentric with the center pivot pin and to transmit longitudinal and overturning loads from the revolving superstructure to the semi-portal.



FOUR-TON CRANES TO HANDLE FREIGHT AT BOSTON ARMY BASE

The center pivot pin is made of a hollow steel casting to permit the threading of conductors through its center to the collector rings on top. The crane is designed so that under normal operating conditions, with a 5000-lb. hook load at the maximum radius, no appreciable load will be thrown on the center pin. It is, however, designed to transmit any possible vertical or horizontal load from the revolving jib crane to the semi-portal bridge without cramping or binding in any part.

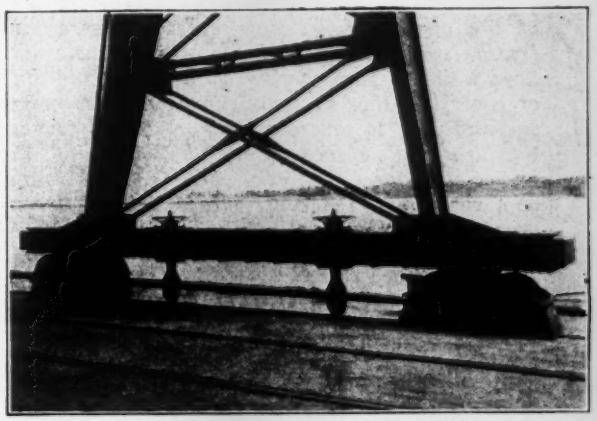
The hoisting and lowering mechanism includes a winding drum, driven through a jaw clutch and a train of spur gearing by a motor equipped with a solenoid brake, and necessary control apparatus and miscellaneous parts. The luffing of the boom is accomplished by a worm-driven drum operated by the hoisting motor through a jaw clutch and gearing so arranged that the boom can be raised or lowered at the convenience of the operator. The pitch of the worm is such that no mechanical brakes are required to prevent the load from lowering; but, as an additional safeguard, a pawl is provided to lock the luffing drum in any desired position.

The slewing is accomplished by means of a motor operated through a train of spur-and-bevel gearing and a pinion meshing with the master gear attached to the semi-portal bridge. A powerful foot brake is provided on this mechanism, having a latch by means of which the brake can be locked for any desired fixed position of the revolving superstructure.

A motor for traveling the bridge is mounted on one of the girders of the semi-portal bridge. This motor is connected to the driven track wheels through spur-and-bevel gearing and line shafting. One truck on the wharf rail is driven and one wheel on the shed rail. A solenoid brake is mounted on the armature shaft extension. Control apparatus for traveling is located in the operator's house. Electrical connections between the conductors on the semi-portal bridge and on the revolving superstructure are made through collector rings mounted on the center pivot pin or an extension of it. In addition to the solenoid brake, hand-operated rail clamps are provided which clamp the wharf rail to hold the bridge in any fixed position.

The electrical equipment is designed for a direct current of 230 volts, with the following motors: Main hoist and luffing, one 65-hp.; slewing, one 15-hp., and bridge travel, one 25-horsepower.

The cranes were furnished by the Wellman-Seaver-



FREIGHT-HANDLING CRANES CLAMPED TO TRACK

Morgan Co., from which this information has been received. The company has installed the cranes under the direction of the Army, Lieut. Col. Charles R. Gow being the constructing quartermaster in charge of the work. Fay, Spofford & Thorndike, of Boston, were the engineers on the base.

Swedish Timber Exports Large

Production of timber from Swedish forests, says the Swedish consul in Chicago, quoted in a recent bulletin issued by the National Lumber Manufacturers' Association, amounts to approximately 40,000,000 cu.m. a year. The total value of exports of wood and lumber, wood pulp, and manufactured goods of wood pulp, is approximately $160,000,000. For April, 1919, it amounted to almost $14,000,000.

Does Rich Concrete in Roads Crack More Than Lean?

It is not uncommon to hear it stated that rich concrete is more susceptible to cracking than lean concrete. The statement is one of those which has gained credence by repetition and for which the evidence is nowhere stated. It is one of considerable importance in the design of roads. With a view to getting more light on the subject, "Engineering News-Record" recently sent out a brief questionnaire to a few engineers who have been prominent in the use of road concrete. The questions submitted were as follows:

1. Does rich concrete crack more than lean concrete?

2. If so, is this particularly the case with concrete highway pavements and foundations?

3. What reason do you assign for the greater tendency to crack in rich mixtures?

4. Would you advocate leaner concrete in roads, to overcome this tendency?

5. What do you consider to be the principal causes of (1) transverse cracks in pavements; (2) longitudinal cracks in pavements?

While the answers to these questions showed the results of some experimentation upon the subject, there seemed to be no well developed foundation for the statement that there is a greater tendency to crack in the richer mixes; in fact, it is apparent that there is a great lack of experimental knowledge on the subjects of cracks in concrete. Several of the engineers to whom questions were sent frankly stated that they knew of no reliable data upon which to base conclusions as to the cracking of concrete either in foundations or in pavement surfaces. As to concrete roads, and road foundations, general agreement exists concerning the immediate cause of cracks, but there is vagueness concerning the contributory causes. It appears to be the general opinion that the mixtures for concrete road slabs should not be weakened in cement content.

Further comment on the subject appears on an editorial page.—EDITOR.

Volume Changes From Climatic Variation Greater in Rich Concrete

BY J. C. PEARSON
United States Bureau of Standards

MY ANSWER to your inquiry of June 19 in regard to highway concrete is based more on general considerations than on an intimate knowledge of the requirements of road construction. Referring specifically to your five questions, I beg to submit the following replies:

1 and 3. Rich concrete in itself has a greater tendency to crack than lean concrete, due to its greater volume change under varying conditions of moisture and temperature.

2. This is particularly the case with highway concrete, unless the design is such as to take care of the volume changes.

4. I would advocate the use of leaner concrete in roads if there were any assurance that the quality of the workmanship in mixing and placing could be controlled. For example, the use of a larger proportion of coarse aggregate in the commonly specified mixtures would undoubtedly result in better roads, provided the contractor were willing to do the necessary additional work in properly placing the leaner mixtures, and the builder were willing to pay for the additional work and the improvement in quality. As a general proposition, it would hardly be wise at the present time to recommend the use of leaner mixtures.

5. Transverse cracks are in many cases due to shrinkage; longitudinal cracks are more likely to be due to lack of uniformity in sub-base conditions.

Leaner Concrete in Roads Would Lead to Failures as Heretofore

BY WILLIAM D. UHLER
Chief Engineer, Pennsylvania State Highway Department, Harrisburg, Penn.

IN MY ESTIMATION there is no practical difference as far as cracking is concerned, due to the difference in richness between 1:2:3 concrete as wearing surface and 1:3:6 concrete as base. I am conversant with the results of many laboratory tests which seem to tend toward proving that the use of rich concrete minimizes the tendency toward cracking due to the absorption of water.

I would most assuredly not recommend the use of leaner concrete in concrete roads. Such cracking as has occurred on our reinforced-concrete roads is easily taken care of by the use of asphalt or tars, at a very slight expense. I feel that the use of lean concrete would but lead to such failures as were experienced in the early history of concrete pavements.

We have made a survey of some of our reinforced-concrete roads in this state, and the cause of cracking is given in the percentage table herewith:

	Transverse, Per Cent	Longitudinal, Per Cent	Irregular Per Cent
Drainage	43	30	44
Weak subgrade	8	63	42
Road entrance, etc.	30	3	10
Trees	8	4	
Culverts	8	..	
Trolley crossing	3	..	4
Total	100	100	100

The Stronger the Concrete the Fewer the Cracks

BY EDWARD N. HINES
Chairman, Board of Wayne County, Michigan, Road Commissioners, Detroit, Mich.

THE Board of County Road Commissioners of Wayne County, Michigan, has, during the past 11 years, constructed approximately 180 miles of concrete roads, which are giving excellent service at a very reasonable maintenance cost. I am impressed, first, by the fact that to me your questions imply that a crack in a concrete road necessarily constitutes a grave defect. In my opinion, this is far from being the case. When one can ride over these roads and cannot tell, with his eyes closed, of the existence of any cracks, they certainly cannot be considered as affecting seriously the service that the road renders to the public.

To answer specifically your question as to whether more cracks will occur with a rich concrete mixture

an with a lean mixture: I have never seen, or, from inquiries that I have made, can I learn of, any data of a scientific character which would give a definite answer to the question. My observation leads to the conclusion that the stronger the concrete the fewer the number of cracks; that is, a concrete of a rich mixture will develop fewer cracks than one of a leaner mixture.

The best evidence I can cite in support of this statement is gained from my knowledge of a considerable mileage of concrete roads in California. These roads were built, as I am informed, of 1:2½:5 mixture; considerably leaner than what we have used on our Wayne County roads, 1:1½:3.

On the California roads it is to be observed that transverse cracks occur at intervals of 12 to 18 ft., while on our roads in Wayne County the interval is much greater. On a number of miles of roads in Illinois, of which I have knowledge, the interval between cracks is 30 to 40 ft. To me, a layman, it is inconceivable to suppose that a weaker concrete road surface would have fewer cracks than one which was stronger, as your questions would imply.

The above will answer your first four inquiries. As to the fifth, concerning the cause of transverse and longitudinal cracks, my observation inclines me to the opinion that transverse cracks are caused primarily by the shrinkage or contraction of the concrete, while longitudinal cracks are mainly caused by unequal movements of the subgrade, doubtless due to imperfect drainage conditions.

Laboratory Experiments Indicate Rich Concretes Crack More

By P. St. James Wilson
Acting Director, United States Bureau of Public Roads

ANSWERING your questions in the order in which they were propounded, it is our belief that there is a tendency for rich concrete to show more frequent cracking than lean concrete, and this tendency is borne out by the results of laboratory experiments. Experiments were made in this office and the results were published in our department Bulletin No. 532, entitled "Expansion and Contraction of Concrete and Concrete Roads." In this bulletin it is shown that rich mortars shrink more when dried out than lean mortars, and it is reasonable to suppose that the same tendency exists in concretes but to a less marked degree. We believe that in view of the tendency for concrete bases to remain in a rather damp condition the shrinkage effect, due to the drying out of concrete, is generally quite small, and that the difference between the shrinkage of rich and lean concrete bases must also be quite small, due to this cause. We believe that temperature effects are about equal, whether the base is rich or lean.

It is our belief that in view of the tendency of concrete pavements and foundations to retain some moisture on account of their contact with the underlying subgrade, the tendency toward cracking should be less than in the case of constructions which are subjected to a more thorough drying.

It has been shown by a number of investigators that neat portland cement shows enormous shrinkage upon drying, and that as more sand is added the shrinkage is decreased. No attempt will be made to theorize on the reason for this action.

We believe that the use of leaner concrete on concrete bases is not likely to reduce the cracking of the concrete to any great extent. We can conceive, however, of a concrete being so lean and so porous that cracking may result from frost action. It is our belief that such action has occurred in many cement sidewalks in which an excessively lean base has been used.

Lean Concrete Pavements of No Value Whether They Crack or Not

By A. N. Johnson
Consulting Highway Engineer, Portland Cement Association

REGARDING the relative amount of cracking to be observed in lean and rich mixtures, I have never seen any results, compiled from any authentic source, that bear out the suggestion that a concrete pavement made of a lean mixture had fewer cracks than one of a richer mixture.

A lean concrete pavement is of no value whether it cracks or not, and it is beyond my comprehension how such a proposition could arise. The results of my own observation are exactly to the contrary—that the weaker the concrete the greater the number of cracks to be observed, other conditions being the same.

Your fifth question, as to the cause of transverse and longitudinal cracks, I believe has been fairly well discussed, transverse cracks being caused in by far a greater number of instances through contraction of the concrete slab due to both shrinkage of the concrete at the time of setting and to contraction due to drying out and the lowering of the temperature.

Longitudinal cracks are for the most part caused by movement of the subgrade which is not uniform throughout its extent. In general, the fact that a crack does appear in a concrete road by no means indicates that the road renders less effective service for the passage of traffic, and practical experience shows that the average crack which occurs occasionally is no serious defect to the road surface.

Within Limits of Allowable Proportions, No Difference in Cracking

By Clifford Older
Chief State Highway Engineer, Illinois

REPLYING to your recent letter propounding questions concerning concrete and concrete pavements, I wish to offer the following replies:

1, 2 and 3. Within the limits covered by the proportions usually used in mixing concrete, I do not believe that there is any appreciable variation in the tendency to crack.

4. I would not advocate using leaner concrete in roads with the idea of overcoming a tendency to crack, since I am not convinced that this procedure would accomplish the end desired. I personally feel that the proportions of the concrete should be determined to give the required strength to the pavement. In fact, my ideas along this line are fully stated in an article on pavement design, published in *Engineering News-Record* of May 8, 1919, p. 905.

5. (a) There has been a great deal of conjecture as to the causes of cracks in pavements, and I hardly feel that anyone can give an absolutely correct answer

to such a question. In my opinion, transverse cracks in pavements are formed due to the alternate expansion and contraction under temperature change. Also, the fact that a pavement occupies a greater volume at the time of its construction than it occupies after the concrete has attained its full set may have some tendency to produce the transverse cracks. I feel, however, that transverse cracks in pavements are of minor importance. We have experienced no difficulty in maintaining such cracks with bituminous material so that they are absolutely protected at a very nominal expense; (b) the cause of longitudinal cracks is also more or less problematical. However, I have observed that pavements 10 ft. in width or under have practically no tendency to crack longitudinally, whereas pavements having a width of 16 ft. and greater almost invariably develop longitudinal cracks. I feel that this is due largely to the difference in the saturation of the soil from the edges toward the center of the pavement. This, combined with freezing, will naturally cause a greater displacement at the edges than at the center, which results in a flexural stress along the center line, producing a tendency to crack. Also, this saturated condition without the action of freezing may cause the center of the subgrade to be more firm than the outside portions, which might produce flexural stress under traffic, resulting in a tendency to crack longitudinally.

I have also observed that longitudinal cracks almost invariably start at a joint or at a transverse crack. I have wondered if this is not due to eccentric application of the compressive stresses set up by expansion. It is well known that an eccentric application of a compressive stress on any concrete specimen tends to cause irregular stresses. In placing joints in a concrete pavement, it would seem almost impossible to get a uniform bearing of the ends of the slab against each other. Compressive stresses might then be applied very irregularly, resulting in a tendency to split the pavement longitudinally. The same theory might apply in the case of the transverse cracks tending to form longitudinal cracks.

This department has adopted the practice of building concrete roads and also brick roads without transverse joints, and, so far as we have been able to observe, there is less tendency to crack longitudinally in the case of the pavements built without transverse joints than with the pavements built with transverse joints.

No Reliable Evidence To Support Rich-Mix Cracking Theory

By Duff A. Abrams
Structural Materials Research Laboratory, Lewis Institute, Chicago

I KNOW of no reliable evidence which indicates that concrete pavements of lean mixtures crack less readily or frequently than rich concrete, particularly if the terms "lean" and "rich" are applied within the practicable range of concrete mixtures.

Past experience in several communities has shown that lean concrete mixtures do not give satisfactory results in concrete pavements. Entirely aside from the consideration of cracks, lean mixtures will not stand up under the extreme conditions of weather and traffic to which a modern road is subjected.

The principal cause of transverse cracks in pavements is the expansion and contraction due to variations in temperature and moisture. The earlier concrete-road builders attempted to counteract the opening of cracks by placing joints at intervals of 25 to 40 ft. However, experience has shown that these joints are unnecessary and that it is difficult to get the pavement at the sides of the joints at the same grade. Considerable expense is saved and better riding surfaces are, consequently, secured by reducing the joints to a minimum. The most modern practice is to place joints only at the end of each day's work. Ordinarily, this would mean one joint at each 200 to 500 ft. If transverse cracks open at other points they can be easily maintained by use of tar or some other bituminous filler. Such cracks are in no way detrimental to the structural efficiency or usefulness of the pavement.

Longitudinal cracks are generally due to inequality in the subgrade which results in nonuniform settlement of the slab. They are sometimes produced by frost action or in the unequal loading of the pavement. In the practice of constructing wide concrete roads over old macadam bases of narrow width, the unequal settlement of the paving slab, due to the newly formed subgrade, causes longitudinal cracks. Old macadam roads should be thoroughly broken up and rerolled before a concrete pavement is constructed. Experience has shown that reinforcement has little or no effect in preventing cracks.

Believes Rich Concretes Have Greater Tendency To Crack

By A. H. Hinkle
Deputy State Highway Commissioner, Bureau of Maintenance and Repair, Columbus, Ohio

YOUR questions are answered in the order in which they are given in your letter.

1. I have also thought that the rich concrete did crack more than the lean, although I have not made sufficient tests to offer much proof of same.

2. This would be more apt to occur in thin slabs of concrete, such as a pavement foundation.

3. I think perhaps the cracking may be less in the leaner concrete due to it being less dense, which may possibly make it more elastic.

4. I would desire to make further investigations before recommending a leaner mix.

5. (a) The principal cause of transverse cracks is the contraction of the pavement; (b) the principal cause of longitudinal cracks is lack of stability of subsoil or too light a slab for the load which the pavement carries.

West Virginia Has World's Deepest Wells

The world's deepest two wells, penetrating to depths of 7579 ft. and 7386 ft., respectively, are the Lake, near Fairmont, W. Va., and the Goff, near Clarksburg. These wells were sunk by the Hope Natural Gas Co., of Pittsburgh, in an endeavor to reach the rich oil-bearing Clinton sand of Ohio, which it was hoped to encounter at depths between 7000 and 8000 ft. Another well, the Geary, was sunk near McDonald, Penn., to a depth of 7248 ft. by the People's Natural Gas Co. It is the fourth deepest, a well at Czuchow, Germany, according to the United States Geological Survey, exceeding the depth of the Geary by 100 ft.

Tests Yield Data on Concrete Columns Reinforced With Cast-Iron Tubes

DATA on the strength of concrete columns reinforced with cast iron have been obtained as the result of tests of 18 members at the Pittsburgh Laboratory of the United States Bureau of Standards. Although such columns have been in use abroad for several years, these tests are the first of this type which have been made in America.

The columns were 12 in. in diameter (inside 1½-in. pitch, 8-gage wire spiral) and were reinforced longitudinally with steel rods and cast-iron tubes. The cast-iron tubes located in the center of the columns varied in outside diameter from 5 to 7 in. with wall thickness of ⅝ to 1 in. The column lengths varied from 6 to 14 ft. Tests were made on samples of the cast iron; also on the concrete used which was proportioned by volumes and consisted of one part cement, one part sand, and two parts gravel, hand-mixed.

The behavior of these columns under loading was similar to that of the ordinary type of steel-reinforced columns. Incipient failure was in all cases accomplished by scaling of the outer shell, which finally spalled off at the surface of the spiral. This was followed by failure in tension of the spiral reinforcing at the maximum load sustained by the column. The protective shell outside the spiral fails at a strain of .00145 (ave.). This is the same strain as that at which the test cylinder failed.

The maximum strength of the column is not quite equal to the strength of the cast-iron reinforcement tested independently plus the strength of the usual type of spirally reinforced column. The cast-iron reinforced column has, however, a much less area of concrete.

The columns commenced to scale at 70.4% (ave.) of the maximum load. Two columns of the same series without cast iron commenced to scale at 89.9% (ave.) of the maximum. The average maximum total load sustained by the various types reinforced with cast iron and of the same length (10 ft.) as the two plain spiral-reinforced columns was 81.5% greater than was sustained by the plain spiral columns. Filling the hollow core of the cast-iron tubes apparently adds 6700 lb. for each square inch of cross-section thus filled. Varying the radius of gyration of the cast-iron tubes, the net cross-section area remaining constant, does not apparently affect the ultimate strength of the column. Cast-iron I-sections were used instead of tubes in two of the columns, the results comparing favorably with the tube columns having the same percentage of cast iron.

The following formula for variation of strength with length is derived from these tests:

$P/A = 12{,}150 - 20\,l$, in which

P = mean stress upon total area of column inside the spiral

A = total area as above

l = length of column in inches.

In view of the general behavior of spirally reinforced columns just preceding failure, it is suggested that a superior type might be developed if the protective shell outside the spiral were applied after the column has been cast and the forms removed. This shell should be of some material possessing the necessary heat-insulating qualities and the ability to withstand without failure a considerably greater strain than .0015 (the strain at which unreinforced concrete fails). This method of construction would also make possible a much greater accuracy in the placing of the spiral.

The complete report of these tests, in Technical Paper 122, United States Bureau of Standards, contains numerous tables, photographs and diagrams, with a discussion of the design of the columns and the results obtained.

Exposure Tests on Steel Sheeting

ACCORDING to a series of exposure tests covering a period of three years and made by Dr. Samuel L. Hoyt, associate professor of metallography, University of Minnesota, sheets of steel bearing 0.20 to 0.25% of copper showed a lower rate of corrosion than any of a number of other commercial products observed. Identical tests were made simultaneously upon copper-bearing steel, bessemer steel and pure open-hearth iron sheets. The results of these tests are given in an article in *Chemical and Metallurgical Engineering* of Aug. 1, 1919.

For test purposes Dr. Hoyt requested manufacturers to submit standard yard-square commercial sheets as specimens. Sheets were submitted in both 20-gage and 26-gage. Chemical analyses of the specimen sheets were then made.

From each sheet specimens 1½ x 3½ in. were cut, marked for identification and after being weighed placed in a rack on the roof of the School of Mines building, where they were continuously exposed to rain, snow and sunshine. Specimens were arranged in rows numbered from 1 to 10, and each row contained a sample from each sheet submitted for test. The rows were cleaned of rust and weighed periodically, the first row at the end of the first period, the second and first rows at the end of the second period, and so on. Thus, the tenth row was cleaned and weighed for the first time at the expiration of three years. These periods were at the end of 1, 3½, 5, 7, 9, 12, 15, 18, 24 and 36 months. Under this test all 20-gage specimens were still intact after three years' exposure. Of the 26-gage samples seven of the nine samples had failed completely before the end of the three years. The author does not define the term "complete failure," as applied to these tests.

The second test was made by weighing specimens after 36 months' continuous exposure. The 20-gage specimens again resisted failure and lost less weight than when periodically cleaned of rust. Only two of the 26-gage specimens completely failed under the second test.

After these tests were completed the relative resistances to corrosion of plain steel, pure iron, and copper-bearing steel were computed.

Iron Ore Output Decreases

Complete statistics of iron-ore mining in 1918, compiled by Ernest F. Burchard of the United States Geological Survey, show a decrease of 4.7% in output, but an increase of 2.6% in value, as compared with 1917 figures. The quantity of ore shipped from mines in 1918 was 72,021,202 gross tons, valued at $244,368,147, an average price at the mine for the whole United States of $3.39, as compared with an average price of $3.15 in 1917.

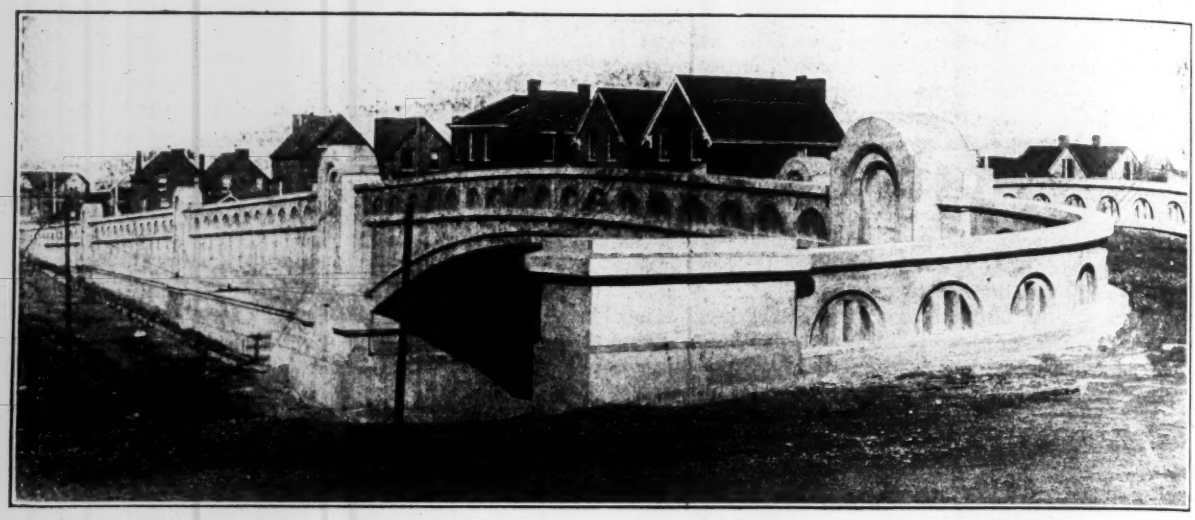
Concrete Ties Hold Together Walls of Bridge-Approach Fill

On Account of High Ground on Line of Bridge, Fill Was Not as Great as Showing Face of the Thin Outer Walls Used

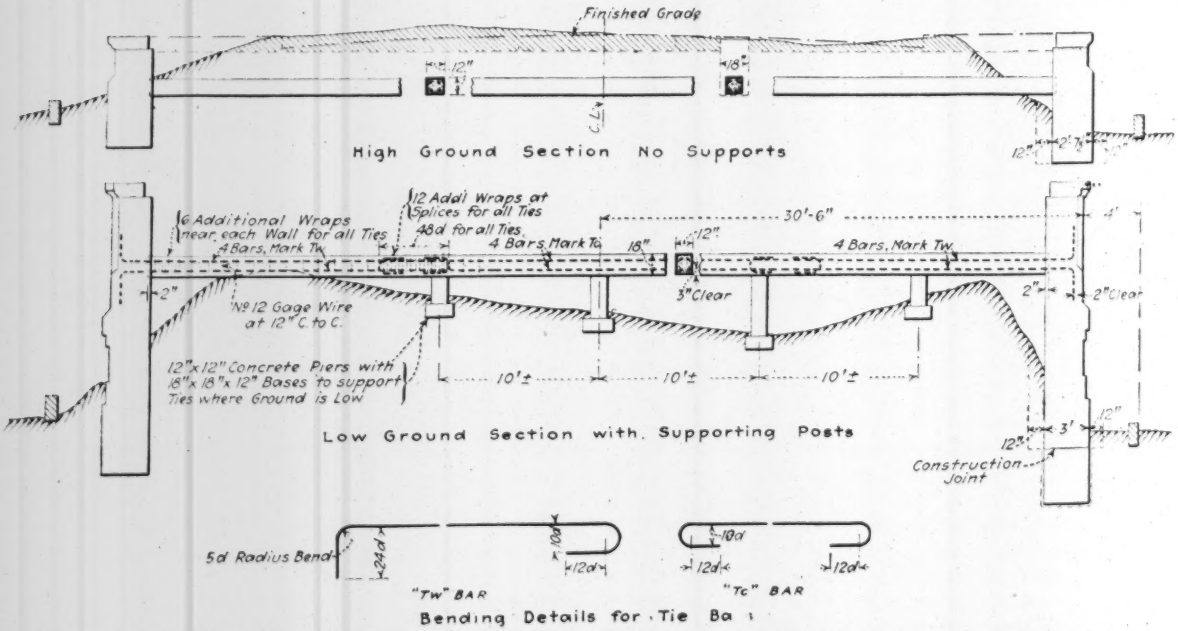
WALLS retaining the fill on the west approach of the new Bellerive Park reinforced-concrete arch bridge at St. Louis, recently completed, were made of fairly thin concrete sections which were held together across the 60-ft. width of the bridge by reinforced-concrete ties spaced about every 20 ft. This peculiar type of construction was available on this bridge because of the topography.

The bridge carries Kingshighway Park, a portion of the boulevard system of the City of St. Louis, over Broadway into Bellerive Park. The boulevard, which is 125 ft. wide, approaches Broadway from the west, and when a block distant from Broadway divides itself into a middle portion, 61 ft. wide, which is carried over Broadway on the new bridge, and two 32-ft. side streets which extend along each side of the new bridge with a descending grade to meet the grade of Broadway. The ground adjacent to Broadway lies about 10 ft. above it, so that when the side streets of the boulevard were cut down to meet the grade of Broadway a high bank of solid earth was left between them on the site of the new bridge.

Advantage was taken of this situation in building the west approach to the new bridge. This was done by building walls of comparatively thin sections along the sides of the embankment and tying them together with reinforced-concrete ties supported on the solid fill. In a few cases where the embankment was not high enough the ties were supported on concrete posts.



LONG APPROACH ON FAR SIDE RETAINED BY THIN WALLS CONNECTED TOGETHER WITH CONCRETE TIES



DETAILS OF REINFORCED-CONCRETE TIE RODS BETWEEN RETAINING WALLS OF BRIDGE-APPROACH FILL

The view herewith is taken from the short approach side looking across the bridge toward the tied retaining wall.

Details of the construction are shown on the accompanying drawing. The wall was 205 ft. long, and varied in height from a few feet to 20 ft. The surface of the original ground between the two walls was variable, but no fill was required greater than 8 ft. The wall itself was of solid concrete varying from 2 ft. 4 in. to 3 ft. at its maximum width, that width being reduced a few inches by ornamental molding. The ties were of two sections, one 12 x 12 in., the other 12 x 18 in., the larger size being used where the tie had to span between posts. The 12 x 12-in. section, as shown, was used where the intermediate earth rose so high that a channel could be dug in it for the placing of the tie. Where the deeper tie was used, posts spaced about 10 ft. c. to c. were used between the walls. All ties were reinforced with four corner rods and splices were made by long bends, in which the length of bend was at least 12 times the diameter and the space between the upper and lower section of the bend at least 10 diameters. The bends were, in addition, wired at all splices.

The bridge was built by the Division of Bridges and Buildings of the City of St. Louis, L. R. Bowen being engineer of bridges and buildings.

State and Federal Control of Land Drainage Needed

Control by Districts Does Not Meet the Larger Problems—Systematic Study and High Engineering Ability Required

By Arthur M. Shaw
Consulting Engineer, New Orleans, La.

In dealing with questions affecting or promising to affect the entire human race, the people of this country have given evidence of a most altruistic spirit, but in their own internal affairs they often follow the narrow lines of thought and action of tribal days, and this in matters which touch vitally the fundamental resources of the country. We have begun to realize the injustice to this generation and to succeeding generations that would follow the continual waste of natural deposits of oil, gas and coal, but little of real and general value has been done, either by the Federal Government or the state Governments, toward compelling and assisting in the conservation of our most valuable agricultural resources. Exception should be made to the foregoing as regards the educational and advisory assistance rendered by our various agricultural colleges and by the Federal and state departments of agriculture, and to some extent by the Department of the Interior.

With the exception of the work that was done by the Reclamation Service, which was done primarily for the purpose of marketing public lands, little assistance has been rendered or work done by the Federal Government which might not be classed as educational or advisory. The same is generally true of the various states of the Union.

The principal engineering questions involved in the conservation and development of our agricultural resources are connected with road building, irrigation and drainage, and it is in the last-named matter that, it is felt, the country, and its engineers as leaders, should now take an interest.

It may be urged that great progress has been made during the past generation by the enactment of state laws enabling the organization and operation of drainage districts which made possible the combination of interests of various owners. This is true, but such a step corresponds only to the social evolution from the family to the tribe, and does not square with our ideals as a nation.

District Control of Drainage Inadequate

To illustrate the fact that district control is not adequate, the following examples which have come to the writer's notice are cited:

1. In northern Illinois a glacial basin was reclaimed by cutting through the limestone rim which obstructed the natural but inadequate outlet and the construction of a system of main interior canals. The entire area is now under cultivation, and there can be no doubt that, in general, the works were well planned and the benefits derived have fully justified the expense. In the operation of the district, however, certain collateral interests were affected adversely, and the drainage district appears to be lacking in both the necessary machinery and in incentive to correct these conditions. Above the district, tributary streams have eroded excessively, destroying valuable farming land and cutting deep gullies which interfere with the conduct of farming operations.

Below the district, sand is deposited on farming lands which, before the improvement of the drainage above, were free from silt- or sand-bearing waters.

2. A recent article in *Engineering News-Record* (May 1, 1919, p. 876) describes the channel rectification of the south fork of the Forked Deer River. The author states that the new channel was purposely designed with a restricted area, with the idea that it would increase by erosion during each period of high water, thereby securing a channel of the required width without expense for the additional work. From the description given, it would appear that the expected process is going on, per schedule. While the writer confesses to only a superficial knowledge of the lands adjoining this stream, and especially those along the main Forked Deer River, it is assumed that the character of the country is not far different from that in other portions of the Mississippi Valley between Cairo and Baton Rouge.

If such is the case, it is quite possible that the net result of this method of dredging may not be all that may be desired. The residents of the lower flats may not take it kindly if they find that a recently planted field of corn or cotton has been covered over night by water that has left a layer of several inches of sand, gravel or clay on top of the infant plants. Some of the lands of the Yazoo delta country are occasionally treated to such unwelcome increments, and it is not an uncommon sight to see a fence more than half buried in silt, and railroad tracks which have been raised several times to keep them above the changing level of the ground.

These cases arise more particularly at or near

the entrance of the silt-bearing streams into the flat lands of the delta country.

3. In the reclamation of the marsh lands of southern Louisiana two problems are faced by the individual districts or owners. The problems might better be handled by a higher authority, having power to communize the interests of the entire section. These problems are those of the protection against storm tides, and the securing of adequate outlets for the discharge of the artificial drainage systems. Under present conditions, each individual drainage project must erect a protection levee of sufficient height to prevent the entrance of water resulting from storm tides, these levees being from 3 to 10 ft. high. Provision must also be made for a drainage outlet to the Gulf. In the past the tendency has naturally been to select for reclamation only those tracts that are most favorably situated so far as natural protection, outlets and transportation facilities are concerned.

An unnecessary handicap to the progress of the country has resulted, which might be avoided at a nominal cost per acre of lands benefited if a comprehensive plan of protection and system of outlets were perfected. Many of the existing pumping plants discharge into small bayous which are already becoming overtaxed. As the development of the section progresses, the question of adequate outlet will become acute.

Many Drainage Problems Interstate in Scope

Many drainage problems are interstate in their scope, and their development requires special legislation by the states interested, to make it possible to carry out a logical plan. The result is that a delayed and often unsatisfactory plan is finally reached, or an attempt is made to handle the work subject to the artificial limitations of the state line. The objections to the latter course are obvious.

Fortunately, we have few drainage problems which are international, such as that of the valley of the Red River of the North, and it is probable that each of these can best be handled by special diplomatic arrangement between the countries involved.

Those states with the conditions of which the writer is familiar have enacted laws making it possible for the people of a community to combine for the purpose of securing drainage of their lands, but the starting of a drainage project depends on the initial step being taken by some interested individual or group of individuals, usually entailing some considerable personal obligation to meet expenses until such time as a district may be organized. As the benefits to be derived apply only to comparatively few individuals within the district, and the money is to be spent by them, and as the drainage commissioners are frequently, if not usually, land owners of the district, it is not strange that methods are sometimes followed which do not give evidence of a desire for the promotion of the "greatest good to the greatest number."

They understand that a flagrant and obvious disregard of the rights of others will result in expensive litigation, but they are frequently adept at drawing the line just outside the courtroom. At least one state (Louisiana) has passed a law which requires the approval of plans by the Board of State Engineers before work may be undertaken by a drainage district, but this does not apply to private projects. Also, the board is so handicapped by lack of funds and personnel that it can give only superficial attention to the projects coming before it. But the law is a step in the right direction.

It is not urged that either Federal or state agencies interfere unnecessarily with private or district drainage enterprises, or that large amounts of public funds be appropriated for the improvement of private property. In other words, neither public ownership nor "pork-barrel" politics is advocated; but it is felt that present conditions justify action somewhat as follows:

1. A systematic study of the needs of each section. This can doubtless be done best by the extension of the present "drainage investigations" of the United States Department of Agriculture, assistance being rendered by the various state agencies.

2. The preparation of a comprehensive plan in detail for furnishing main outlets and flood protection for each section. This will require the employment of engineering ability of a high order.

3. The construction of main drainage canals and protective works as required.

4. Compulsory compliance of private owners or district officials with plans prepared or approved by proper authority.

The expense of the preliminary examinations should be borne by the Federal and state Governments, and the cost of the succeeding steps by the owners benefited, the projects being assisted by a suitable method of underwriting the bonds of properly organized districts.

To quiet the qualms of those who are fearful of too much interference by the Government with private matters, attention may be called to the fact that we are already supplied with ample precedent in the method of handling the railways of the country, stream control for purposes of navigation, eradication of the cattle tick, control of the citrous-fruit scale, etc., and, more recently, regulations concerning the conduct of the individual in certain matters of refreshments.

Wyoming Establishing Road-Patrol System

Maintenance on Wyoming roads is just being inaugurated on the patrol system. Two engineers are establishing patrol crews on the state roads and through routes, making the sections from 10 to 25 miles in length.

For a man with a team a section of 10 to 15 miles is given. He is equipped with a light grader drag and small tools, and is instructed in their use. Supervision of the patrolmen is then turned over to one of the five district engineers. For longer sections, two men are placed on one of the larger 3- and 3½-ton Army trucks, of which the state has already received 100. Improved road is about the only sort on which the larger trucks can be used, for the culverts on roads with less traffic, and the surface conditions in construction work, preclude their extensive use. Heretofore about $70 per mile per year has been spent on the improved state roads, mostly in grading. Now it is planned to put $200 or $300 per mile into them. The Yellowstone Trail and the Lincoln Highway were about 75% covered by patrolmen Aug. 8, according to Z. E. Sevison, state highway engineer.

D. S. McCalman, formerly a contractor on the Vermilion County roads, in Illinois, is superintendent in charge of maintenance.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

As Others See Us

Sir—Your issue of Aug. 21, 1919, contains two statements, both under the heading, "As Others See Us." One is made by Mr. Leighton (p. 387) quoting from "a great man and a high-minded politician," and the other is your editorial comment (p. 345) that "there is enough truth in them (the 'great man's' remarks) to shame our profession." Really, these statements do hurt and cut deeply. The "high-minded politician," when speaking of engineers, is reported to have said, "their aloofness and indifference to all matters outside of their own professional sphere are among the unexplainable things in our political life."

Let me ask with you, "Are these views correct?"

What is the difference between a successful professional engineer and a politician, in the highest sense—a man who devotes himself to the affairs and the art of government, who is a statesman, endeavoring to shape the ends of civil society as perfectly as possible, a leader in outlining the policies of the people and a guardian of their peace, safety and prosperity?

Both are supposed to be possessed at the outset of a good, broad and liberal education, including a general knowledge of affairs and a sincere desire to exercise their best abilities for the benefit of their communities. But here the equality ends and a different education and experience begin.

The politician studies the history of social evolution and the laws, if he can trace them, according to which, from the past to the present, the actual practical development of large and small communities takes place. He learns how these communities can best be organized and governed, how all the ways and means for a comfortable life and progress of the citizens can be procured and regulated. With this knowledge he then establishes legislative bodies, whose members, from the whole country down to its cities and villages, discuss and deliberate, and decide the multitudinous questions relating to their respective governmental requirements.

The elements with which the politician has to deal are: First, the people themselves, their average qualities, the degree of their development, the ways in which they desire to arrange their surroundings, earn their living, enjoy their surplus, and establish the best relations among the members of their own community and those of other communities, whether these are cities, states or countries. Second, the politician must study the possible future of his community, as determined from the geographical, climatical and physical conditions of the locality, so far as these control its becoming a manufacturing community, a trade or residential center, or possibly a seaport. Third, he must study and put into effect the numerous agencies required for establishing an organization to regulate, carry on and preserve most efficiently the economical life and growth of the community. Fourth, it is the work of a politician to cause the commercial development of a distributing system, relating to the transfer of people and goods within its own community and to and from other communities.

The engineer, on the other hand, studies the materials and forces of nature and their scientific laws which enable him to utilize them for the benefit of a community; makes the designs for building works required to accomplish a desired physical object, and directs their construction and proper operation.

The elements with which an engineer must deal are, therefore, quite different from those required by the politician, because, instead of dealing with social customs, relations and occupations, they deal chiefly with the well known and fixed scientific laws of nature and their application in designing and building up a city, its ways of communication by road, rail, water, telegraph and telephone, its means of lighting, supplying water and food, removing sewage and refuse, establishing factories, parks, etc. The engineer further deals with the ways and means of operating all these works in the most efficient and economical manner.

The politician, in the highest sense, is therefore the organizer, regulator, controller and director of a civilized community and of its people. But engineers, as well as physicians, merchants, teachers, judges, etc., are experts in special community activities, who must be consulted to the fullest extent and whose knowledge must be utilized for the benefit of the community at large. Not only Congress, legislatures and councils, but also every directorate of a corporation—say a railroad—should be made up of politicians in the above sense, of organizers, regulators and controllers, while the executive departments—relating, again as in the case of a railroad, to the design, construction and operation of all of its parts—should be made up of experts specially qualified therefor, as engineers, lawyers, business men, etc.

While these two different activities exist side by side, and each one may require a man's full time and his limit of efficiency, it occasionally occurs and is advantageous that both may be united in the same person. Therefore, engineers and physicians have been also organizers, directors and controllers of large bodies of men. A director of a railroad can often be aided in his judgment by knowledge and experience previously gained as a professional engineer, yet his new duties are no longer those of a designing, constructing or operating officer. The Pennsylvania R.R directorate, for instance, has been greatly benefited by containing a number of engineers. A director or a member or a board of health can be aided in the exercise of his duties by knowledge and experience that he may have previously gained as a practicing physician or sanitary engineer, yet his new duty is regulative and controlling and covers the entire community.

The habits of a professional engineer, gained when dealing with fixed laws and applying them with absolute assurance of success, create a high degree of satisfaction and are not easily departed from when he changes over to the political profession, with its uncertainties, its unpreventable miscarriages of justice, and its efficiency, relying largely on individual experiences, assumptions and personal judgment. Therefore, such engineers, whose dispositions and character do not particularly fit them for directing and controlling activities, have not developed a special taste for political work, but have remained "indifferent" and have naturally

preferred to keep "aloof" from "all matters outside of their professional sphere." We can say the same of most physicians, manufacturers, merchants, etc. As the ability to carry a double professional load is given only to the strongest of men, only a few have actually attempted it and succeeded.

The above reasons seem to me to cover at least one "explanation" why enginers do not more frequently enter into political life. When they have entered it, on account of special fitness for it, their engineering training no doubt made them more successful as public leaders than they otherwise would have been, but their successful activity as professional engineers had to be sacrificed.

RUDOLPH HERING,
Consulting Engineer.

New York City.

Safe Loads on Steel and Wood Beams

Sir—In connection with the subject of simple methods for finding the safe load on steel beams, discussed in recent issues of *Engineering News-Record*, the rule given below is worth remembering. It requires a knowledge of the section moduli of different shapes, but it is equally exact for all shapes.

The safe uniform load W for any steel beam spanning 1 ft., at an extreme fiber stress of 16,000 lb. per square inch, will be $W = 10{,}670\ S$, in which S is the section modulus. For ease in memorizing use $W = 10{,}000\ S$, and, if it is desired to be exact, increase the result by 7%. To find the safe load for any span, divide the value W so found by the span in feet. Thus, the safe uniform load on a 20-ft. span of an 18-in. 55-lb. I-beam (section modulus 88.4) is $10{,}000 \times 88.4 \div 20 = 44{,}200$ lb.; adding 7% to make the result exact, 47,294 pounds.

For a load concentrated at the center of the span, one-half this value should be used. For a load divided between the two third-points, use three-fourths the uniform-load value. The rule given is, of course, readily derived from the ordinary equations for bending moments and resisting moments.

A similar rule for safe uniform loads on rectangular wooden beams is: For a fiber stress of 1600 lb. per square inch, the load for a span of 1 ft. is $W = 175\ bd^2$; for a fiber stress of 1200 lb. per square inch, $W = 135\ bd^2$, in which b is the width of the beam in inches and d is its depth.

HENRY F. BLOOD.

Portland, Ore.

The Sanitary Engineer as Health Officer

Sir—The number of articles favoring the sanitary engineer as a public health officer is increasing, and that fact means that sooner or later the engineer will be recognized as the logical executive to have charge of all public health work, with doctors of medicine as assistants or consultants acting solely in an advisory capacity. This is radical but perfectly logical. It follows that the United States Public Health Service should be in the control of engineers, and that its work would then fall within the proposed Department of Public Works, where it belongs.

The laws generally permit only practicing physicians to hold the office of county or city health officer. This is wrong, especially in view of the fact that there is an increasing number of very efficient health officers who are not medical men. At the present time a sanitary engineer may act as deputy health officer, doing all the work for which he is paid, while the doctor of medicine acts as his superior in the position of health officer and receives all the honor for accomplishing results. A district health officer of the State of California has stated in good faith that but 10% of the duties of health officer requires a medical training.

On every health board, state or city, there should be granted to the engineer equal representation. The doctor of medicine is interested primarily in the cure of disease and not in its prevention. The sanitary engineer practices preventive medicine and is logically the one to see that all things necessary are done to conserve the public health. Practically half of the diseases are due to constitutional causes, while the balance are brought about by bad environment. The engineer deals with environmental causes, while the doctor looks after the constitutional weaknesses. This would permit the engineer to take an active part in civic affairs in one of its phases. There is a crying need for men with engineering training in all board of health work which is universally headed by a physician. It is no reflection on the medical profession to state that not one physician in fifty knows the difference between an activated-sludge plant and an Imhoff tank.

Wider publicity should be given to the changing conditions. The engineer who is employed under unsatisfactory conditions dares not express his views, with the result that the public is not familiar with the sentiment of the men who are most vitally interested. The sanitary engineer in the United States Public Health Service is in no position to defend himself. A certain engineer writes that he was, some time ago, director of sanitation at a certain camp with a medical "officer in charge." He says: "The job was scarcely big enough for one man, and to be annoyed by one unfamiliar with the work but in authority over it, who would speak of 'my engineer' in a superior way and with assumed importance, was a bitter experience. The remedy, I think, lies in organization and publicity. Let the public know it is not getting a dollar's worth of public health-protective measures when it pays a dollar for it, when a top-heavy 'overhead' of inefficient medical officers direct or pretend to direct purely engineering matters, and it will be easier to have sanitary engineers placed in administrative positions. I believe, too, that an organization such as the American Society of Civil Engineers will never in a thousand years do us much good along these lines. It lacks the aggressiveness, is too conservative, and is for the leaders rather than for the rank and file. I am beginning to pin my faith to the American Association of Engineers and to preach organization and publicity for engineers." He adds the remark that all efforts in behalf of the sanitary engineers in the employ of the United States Public Health Service is much appreciated "by the many engineers who are still in the service but who must keep quiet or be disciplined."

EDWARD G. SHEIBLEY,
Hydraulic and Sanitary Engineer.

Riverside, Calif.

[As matters now stand, undoubtedly more engineers should be engaged in public health work, both as health officers and as members of health boards or commissioners of health.

It is only fair to say that the doctors are as likely to chafe at being under engineers as are engineers at being subject to the direction of doctors. The difficulty in either case lies largely in the confusion still existing as to what is the proper education and training for

health officers, but back of this is a lack of clear ideas and rational practice as to the proper function of health departments. From this confusion there are signs of emergence. Some years hence there will be a clearer conception of what falls to the doctor and what to the engineer. Meanwhile, schools may arise that will so shape their courses as to fit men to serve as public health officers, instead of first trying to make them either doctors or engineers.

Once the true function of a health department is generally recognized by the educators and the public, much of the engineering heretofore associated with public health will be turned over to engineering departments—local, state, Federal—and the man educated in public health rather than in private medicine will administer public health work. When that time comes, plumbing, garbage and refuse disposal, water-supply, sewerage and sewage treatment will be in the control of departments of sanitary engineering. Health departments will deal with health as centering in the individual and with communicable diseases as spread by infected persons through lack of proper control by doctors, nurses and responsible householders.—EDITOR.

Engineer Finds Both Direct and Indirect Advantages in Technical Writing

Sir—The following account of how one engineer learned to write may be of interest to your correspondent, J. W. Moulton, whose letter appeared in your issue of Aug. 28, 1919, p. 433:

The writer was present at one of the meetings of the American Society of Civil Engineers when a particularly dry and uninteresting paper was being read, and, turning to a friend, said: "Well, they certainly do have some pretty 'punk' papers up here." My friend replied, "Why don't you write one and show 'em how to do it?"

I was at that time one of the very large class of field engineers who either "don't have time to write," or don't have anything to write about, but who kick generally because all the books are written by college professors who don't know anything about practical work. However, my friend's remark rather stuck in my mind, and I finally decided to write a paper for the society which, when submitted, was promptly returned by the secretary as being of no interest, too long, and for various other reasons. I decided to have a talk with him, however, before dropping it, and after some modifications it was accepted and published.

It is to be noted that the new development committee of the society recognizes the need for encouraging the young engineer both to write and take part in the discussions. This the committee does, instead of taking the erstwhile passive attitude which has often appeared to be merely to endure the intrusion of the younger members.

To get back, however, to the question of writing: My own experience has been that writing articles or other matter for which direct remuneration is received seldom pays directly; the amount of money received being a very small compensation for the time and labor involved. If a writer's works become favorably known, however, his fame and reputation are thereby enhanced. But to my mind the chief value comes to the writer by reason of the fact that when he "takes his pen in hand" to write something for the critical perusal of others, he finds out there are many things he really does not know that he thought he did. If he sticks to it, he finally does get to know them in a way he never otherwise would.

As this touches on a more or less personal matter, I beg to be allowed to subscribe myself simply as

A WRITER.

Questions on Anchorage and Lateral Sway in Cumberland Suspension Bridge

Sir—Your issue of July 3, 1919, contains (p. 4) an interesting description of a suspension bridge over the Cumberland River near Nashville, Tenn., built for the du Pont Engineering Co. This bridge has several unusual features, especially the design of the concrete anchorages. It is stated that the bridge is designed for a live load of 400 lb. per lineal foot, which with 8-ft. roadway equals 50 lb. per square foot. Considering that a great crowd of people pass over it morning and evening, this can hardly be called excessive.

Assuming that the designer's computations are correct, this live load combined with the dead load causes an uplift on each anchor of 770,000 lb. To take care of this uplift the anchor rods are embedded in a concrete block 20 x 11 x 39 ft., containing 8580 cu.ft. of concrete weighing about 1,158,000 lb., or about 50% in excess of what is required.

This may be good enough, ordinarily. However, it is mentioned that high water overflows one bank regularly. The buoyancy of this concrete block amounts to 536,000 lb., leaving a dead weight of 622,000 lb. to take care of 770,000 lb. uplift. There may be some side friction and suction, but hardly sufficient to overcome a shortage of 148,000 lb., especially as it appears from the views that the anchorages are not even completely buried. May we hope that the dead load for this bridge was assumed heavy enough, and that it will never be tested to its full capacity, or it may provide an easy and convenient access to a point far beyond the powder plant for the 14,000 persons who pass this bridge daily.

The writer has tried to design some suspension bridges, and has found it no easy problem, especially to provide against the span swinging sideways. It would be interesting to know how this bridge acts in that respect, as it is built without wind cables. In spite of the facts that it has exceptionally heavy laterals and that the cables are slightly cradled, one should think there would be considerable swing sideways in a span with a ratio of length over width of 60.

D. ORDING,
Assistant Engineer, the Midland Bridge Company.
Kansas City, Mo.

Sir—The writer has had the privilege of reading the interesting discussion of Mr. Ording on the suspension bridge at Nashville, which brings out some of the conditions in engineering design calling for the best judgment on the part of the designing and field engineers.

In regard to the stability of the concrete anchorage, Mr. Ording assumes that when the river overflows the bank, full hydrostatic pressure will be exerted on the anchorage. The river does overflow the east bank in the high-water season, and for that reason very careful consideration was given to the design and construction of this anchorage. Three types of anchorages were submitted, and the type described in the issue of July 3 was finally selected.

The ground on the east bank was silt for a depth of about 3 ft. Then came some hard gravel, and finally hard clay was reached. Piles were driven under the east anchorage and also under the east tower foundation, these piles averaging about 25 ft. in length below the cutoff. The view of the concrete anchorage, Fig. 5 in the article, shows this anchorage during construction. Wherever any space existed between the concrete and the side of the excavation, this space was filled in and rammed hard so as to make it very unlikely that anything approaching full hydrostatic pressure would be exerted on the anchorage, as this filling was practically impervious.

Mr. Ording comments on 50 lb. per square foot not being an excessive live load. The bridge is 8 ft. wide, so that four men abreast is about the maximum that it will hold. Assuming the weight of the average man on the bridge to be 150 lb., the weight of a file of four men would be 600 lb., so that in order to get 400 lb. per lineal foot (50 lb. per square foot for a width of 8 ft.) the files would have to be 18 in. apart for a distance of 540 ft., or entirely too close for convenience in ordinary walking. The writer has often watched the crowds coming off the ferry-boats and in the subway and elevated entrances and exits, and, while the congestion is close around the gates, as soon as the crowd starts moving the distances between the individuals increase, and, except in case of a local congestion, the distance between files of people averages from 2½ to 3 feet.

For the suspension bridge, with a width of 8 ft., it is hardly likely that the men will average more than three abreast, which at 150 lb. per man will be 450 lb. per file; assuming the files to be 2½ ft. apart, we get a live load of 180 lb. per lineal foot, which seems a fair value considering that it extends over a distance of 540 feet.

Furthermore, the concrete was assumed to weigh 135 lb. per cubic foot. This is a low value, as from our experience concrete runs very close to 150 lb. per cubic foot.

The actual dead load of that part of the span producing a pull on the anchorage is 575 lb. per lineal foot, as against an assumed dead load of 550 lb. per lineal foot. This dead load will produce an uplift of 466,000 lb. A live load of 180 lb. per lineal foot will produce an uplift of 146,000 lb., making a total uplift of 612,000 lb. Assuming 8580 cu.ft. of concrete at 150 lb. per cubic foot, we get 1,287,000 lb. About 10,000 lb. of anchorage steel was embedded in the concrete, which, making allowance for the difference in weight between steel and concrete, will add 7000 lb., making the total weight of the anchorage 1,294,000 pounds.

The margin of safety, then, under normal conditions would be 682,000 lb. If under flood conditions, with the bridge fully loaded with 180 lb. per lineal foot, full hydrostatic pressure were exerted on the anchorage, this margin would be reduced by 535,000 lb., leaving a net of 147,000 lb. Should the concrete only weigh 135 lb. per cubic foot, the net margin would still be 18,000 lb., on the assumption that full hydrostatic pressure were exerted on the anchorage. It is the judgment of the engineers, however, that full hydrostatic pressure will never be realized.

Mr. Ording also comments on the absence of wind cables. This point also received careful consideration at the time when the bridge was designed. He calls attention to the fact that heavy laterals were used. It will also be noted that the chord members were extra-heavy.

The maximum live-load chord stress was 108,000 lb., requiring an area of 7.8 sq.in. net for tension or 9.8 sq.in. gross for compression. The largest chord section used, two angles 6 x 6 x ¾ in., has 16.9 sq.in. gross and 13.9 sq.in. net area. This excess, together with the cradling of the cables, was assumed to take care of the 10 lb. per square foot wind on the partially loaded structure without too much swaying of the span. For either a 10-lb. wind on the fully loaded structure or a 25-lb. wind on the unloaded structure, the full gross and net areas of the chord angles are available, since the stiffening truss takes stress from neither dead load nor live load over the entire structure, but only from a partial live load.

To sum up, the writer believes that full hydrostatic pressure will never be exerted on the anchorage, and also that the amount of swaying of the bridge will not be excessive.

WILLIAM G. GROVE,
New York City. American Bridge Company.

Further Researches in Rodding Concrete

Sir—In *Engineering News-Record* of May 15, 1919, p. 957, there was published a preliminary report of some tests conducted at the University of Texas, tending to show the value of "rodding" concrete; that is, of agitating the new and wet mixture with a pointed iron rod. Since that time some further results have been reached which seem to be worth publishing.

Fig. 1 (next page) shows graphically the ultimate unit compressive strengths of fifty-four 6 x 12-in. cylinders. The concrete had the following composition:

Material	Percentage
Cement	14.40
Passing 35-mesh sieve	4.35
Passing 12-mesh sieve and retained on 35-mesh sieve	9.00
Passing ¼-inch sieve and retained on 12-mesh sieve	13.00
Passing ¾-inch sieve and retained on ¼-inch sieve	29.50
Passing 1½-inch sieve and retained on ¾-inch sieve	29.75
	100.00
Water	10.00

The 54 cylinders were divided into three groups of 18 each. In each group one cylinder was not rodded, the remaining 17 were rodded at stated intervals from 1 to 17 times. In one group a 10-min. interval was allowed between roddings; in another a 20-min. interval; and in the third group a 30-min. interval. The first rodding was applied soon after the molds were filled; i.e., without waiting for the full interval of time assigned the particular series to pass. By one rodding is to be understood the pushing of a pointed iron rod into the concrete, to the full depth of the concrete, once for every surface area of about 3 sq.in.; i.e., about ten times for a 6-in. cylinder.

It is interesting to note that the maximum strength is about 130% more than that of the unrodded specimens and that all three series acquired their maximum strength in about 2 or 2½ hours. It is probable that the length of time and the number of roddings necessary to secure the maximum strength vary with the temperature and with the percentages of cement and water.

Fig. 2 shows graphically in the upper part of the diagram the average ultimate unit compressive strengths of thirty-six 6 x 12-in. cylinders arranged in 12 groups

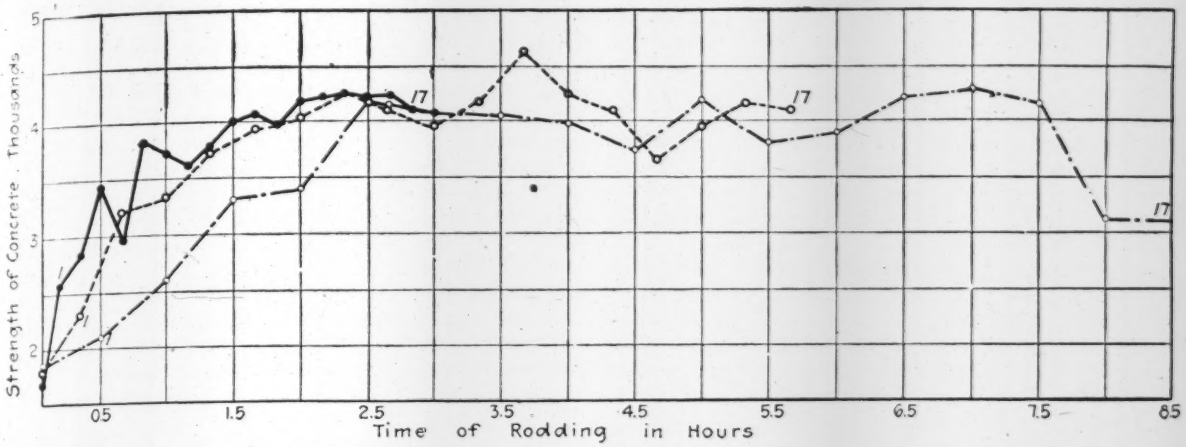


FIG. 1. VARIATION IN INCREASE OF STRENGTH OF CONCRETE WITH NUMBERS OF RODDINGS

of three cylinders each. The intermediate group was made of concrete having the same composition as that represented in Fig. 1; but the mixing water was 7% for three cylinders, 8% for three, 9% for three, and 10% for three. This concrete contains cement at the rate of about six sacks of cement per cubic yard of concrete.

The two other groups are of similar composition, but the cement content changed to about four and eight sacks, respectively, per cubic yard. The percentages of water for the lean mixes were the same as for the intermediate, but for the rich mixes they were increased, respectively, to 7½, 8½, 9½, and 10½ per cent.

To compare these results with the strength of plain concrete, the work of the Lewis Institute of Chicago, as reported by Prof. D. A. Abrams, was selected as being probably the latest and most reliable, and probably also the most appropriate, since it gave special attention to the effect of excess water on the strength of the resulting concrete.

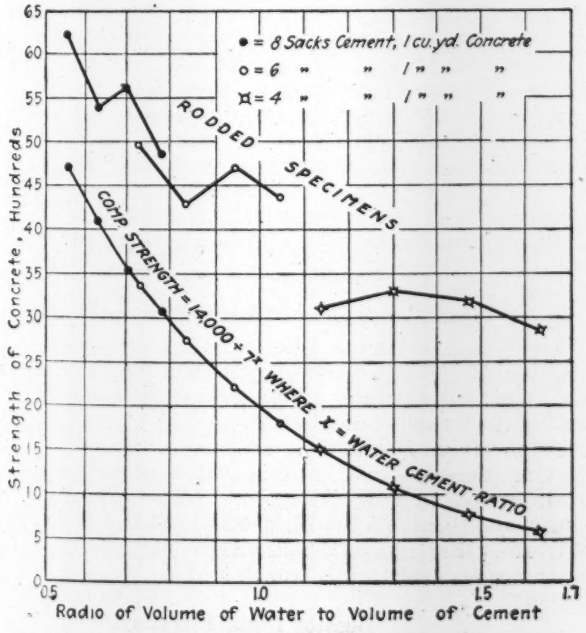

● = 8 Sacks Cement, 1 cu. yd. Concrete
RODDED SPECIMENS
COMP. STRENGTH = 14000 ÷ 7ˣ WHERE X = WATER CEMENT RATIO
Strength of Concrete, Hundreds
Radio of Volume of Water to Volume of Cement

FIG. 2. INCREASE OF STRENGTH OF CONCRETE DUE TO RODDING

According to the Lewis Institute tests, the strength of concrete is a function of the ratio of the volume of water to that of the cement used in the production of the concrete, and is $1400 \div 7^x$ pounds per square inch for cement 28 days old, x being the ratio referred to and the weight of one cubic foot of cement being assumed as 94 lb. The lower curve (Fig. 2) shows the strength of the 12 groups of specimens as calculated by this formula.

An inspection of Fig. 2 shows that the effect of rodding concrete is more beneficial with lean than with rich mixes, that it is more beneficial with wet than with dry mixes and that the average strength of eight-sack concrete can be increased about 45% by rodding; that of six-sack about 60% and that of four-sack about 220 per cent.

To appreciate how well the values shown in Fig. 1 (determined by tests July 11, 1919) check with those shown by the broken line in Fig. 2 (determined by test Mar. 19, 1919) and with those shown by the curved line in Fig. 2 (calculated from the Lewis Institute formula) notice that the average strength of the unrodded specimens shown in Fig. 1 is about 1800 lb., and that this is almost exactly the same as that shown by the curved line in Fig. 2 for the six-sack concrete with 10% of water, also that the strength shown by Fig. 1 increases gradually with the rodding to about 4250 lb., which is only a trifle less than that shown by the broken line in Fig. 2 for the six-sack concrete with 10% of water.

Austin, Tex. F. E. GIESECKE,
Professor of Architectural Engineering and Head of the Division of Engineering, University of Texas.

Additional Data on Bolted Connections

Sir—The use of bolted connections in place of riveted connections is justified, according to the experience of the writer, to a far greater extent than is now permitted in most specifications, and consequently the article by R. Fleming in your issue of Aug. 14, p. 316, "Bolts in Field Connections of Steel-Frame Buildings," meets with hearty approval. The conclusion might well have been made more inclusive, and instead of being limited to building construction it might have been stated as follows: "Bolted connections have a place in *all types* of steel structures. *Each structure* should be considered by itself, etc." For example, in the

case of the most completely riveted form of structure, the railway bridge, could not stringer connections which are solidly embedded in concrete floor material be bolted most satisfactorily? Bridge railings and sidewalk brackets are frequently bolted.

The criterion for making the use of bolts questionable would be the occurrence of vibration, impact or reversal of live-load stress, or inaccessibility after erection (the latter on account of inability to inspect occasionally to test the tightness). Ordinary bolts, such as are under discussion, would become less desirable as the number of pieces and thickness of the material to be fastened is increased. The general use of bolts will undoubtedly increase as the cost of field labor increases and the quality of field work decreases, as the latter would affect field rivets more than field bolts.

The recommendation that for tower connections the allowable shearing stress for bolts be two-thirds the allowable stress in the tension members agrees with the writer's judgment. A slightly reduced ratio might naturally be used for building work, in order to give a higher factor of safety, but it would not seem that any distinction need be made between shop bolts and field bolts.

Allowable bearing values are usually made twice the shearing values, and this practice has been followed in the recommendations, although the tests cited show a ratio of 2.6. The above average bearing value should be termed "Bearing Value for One-sided Connections," as in getting this average Mr. Fleming has rejected the first group of tests, which, in the judgment of the writer, are the only tests shown that give the real bearing values. In this first group the test piece was held between two other pieces, and the bearing values of these six tests average 3.9 times the average shearing value.

The following comparison shows up very clearly the comparative weakness of the one-sided connections due to eccentricity, and the decrease in strength as the connecting bars increase in thickness. The ratio of bearing value to the average shearing value is interesting.

UNIT BEARING VALUE AT FAILURE

(From tests reported by R. Fleming, *Engineering News-Record*, Aug. 14, 1919)

Symmetrical Connections Group A			One-Sided Connections Groups B, C, D and E		
Thickness of Metal, In.	Average Ultimate Bearing Value, Lb. per Sq.In.	Ratio to Average Shear	Thickness of Metal, In.	Average Ultimate Bearing Value Lb. per Sq.In.	Ratio to Average Shear
(2 tests) $\frac{1}{4}$	163,000	4.5	(8 tests) $\frac{1}{4}$	117,175	3.3
(2 tests) $\frac{3}{16}$	148,550	4.1	(7 tests) $\frac{3}{16}$	87,107	2.4
(2 tests) $\frac{1}{8}$	117,600	3.3	(3 tests) $\frac{1}{8}$	70,767	2.0

It appears that actual bearing value is not a fixed quantity or ratio but is a complicated system of failure depending on many variable factors. Some of the ways in which failure can take place and be commonly reported as bearing failure would be: (1) By crushing the material in front of the bolt or rivet shank as cheese would be crushed; (2) by splitting or stretching the material in front of the shank and folding back the edges; (3) by shearing out a piece at the head of the shank as in the end of a wooden piece; (4) elongating the hole by stretching the material at both sides; (5) stretching the material on one side of the hole and bending the other side. Where the material is confined against sidewise deflection and the axis of the bolt is at right angles to the stress, bearing on the shank will be distributed instead of being concentrated at one edge. That is, a bolt with good stiff washers under head and nut should show greater bearing value than one without, and a piece gripped between two other pieces of opposite stress should develop the bearing value most fully. A clause like the following will still insure a greater factor of safety in bearing than in shear: "Allowable unit stress in bearing for rivets and bolts: (a) In general, twice the allowable unit shearing stress; (b) in members clamped between pieces of opposite stress, $2\frac{1}{2}$ *times* the unit shearing stress."

Some tests of bolts were made in 1914 by the testing staff of Milliken Brothers, Inc., using bolts whose material had an ultimate tensile strength of 73,000 lb. per square inch. Their results are summarized in the two following tables:

ONE-BOLT TESTS

Size of Bolt, In.	Load at Failure, Lb.	Unit Shear at Failure, Lb. per Sq.In	Ratio Tensile to Shearing	Unit Bearing at Failure, Lb. per Sq.In.	Ratio Bearing to Shearing
$\frac{3}{4}$	13,600	34,700	2.10	87,500	2.52
$\frac{3}{4}$	13,450	34,300	2.13	86,000	2.50
$\frac{3}{4}$	13,700	35,000	2.08	88,000	2.59
$\frac{3}{4}$	14,500	37,000	1.97	93,000	2.51

TWO-BOLT TESTS

Size of Bolt, In.	Load at Failure, Lb.	Unit Shear at Failure, Lb. per Sq.In.	Ratio Tensile to Shearing	Unit Bearing at Failure, Lb. per Sq.In.	Ratio Bearing to Shearing
$2\frac{1}{4}$	22,550	36,700	1.98	96,000	2.61
$2\frac{1}{4}$	26,125	42,500	1.74	111,000	2.61

In the first set, the bolts were in double shear, with a center bar $\frac{5}{16}$ in. thick and two outside bars $\frac{1}{4}$ in. thick. All failures were by shearing; the bars had settled down to a good bearing pull without indication of bearing failure. In the second set the test pieces were angles $2\frac{1}{2}$ x $2\frac{1}{2}$ x $\frac{3}{16}$-in., connected to thicker gussets at each end by two $\frac{3}{4}$-in.-diameter bolts, spaced 2 in. apart, with 1-in. end distance to first bolt. Both failures occurred by splitting out the end of the angle after slightly elongating the holes, and after shearing had commenced.

The writer is acquainted with the details of a large one-story manufacturing building, originally designed for rivets but in the erection of which bolts were used, with $\frac{1}{4}$-in. washers under the nut to hold off the thread. The bolts were $\frac{1}{16}$ in. larger in diameter than the nominal rivet diameter; that is, $\frac{13}{16}$-in. bolts were used instead of $\frac{3}{4}$-in. rivets. Ten-ton transverse cranes run in alternate bays, hung from the trusses. During six years' use the building has not developed any weakness.

WALLACE E. BELCHER,
Engineer, American International Shipbuilding Corporation.
Hog Island, Penn.

What Causes This Water-Hammer?

Sir—What causes this hammer? I have a 16 x 12-in. double-acting piston pump driven by a motor running 50 r.p.m., lifting water 12 ft. from reservoir and elevating it through mains to a 90- or 100-ft. tower tank. At times there is a terrible hammer in the mains and service pipes—so bad, at times, that people have to close cut-off in order to sleep. Valves are in good order, and there is a 7 x 15-in. air-chamber check valve 3 ft. from the pump on the discharge line. Can some of your readers explain this trouble and suggest a remedy for it?

B. GIBSON,
Decatur Light & Water Company.
Decatur, Tex.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Keep Road Forms Clean for Tampers

IT IS as important that the tops of the side forms for concrete roads should be kept clean as that they should be set at proper grade and level. They form templets for the strike boards and mechanical tampers, in finishing the surface, so that obstructions will cause the board or tamper to rise above its proper position. Tamping machines usually have plows in advance of the front wheels for the purpose of cleaning the tops of the forms, but these are not always adjusted for close contact with the form, in which case they become inoperative. On road work recently visited, the forms were almost completely covered with concrete spilled over them, and on this the wheels of the tamping machine traveled with an irregular and jerky motion. Particles of aggregate were either crushed under the wheels or caused the machine to ride over them, with a perceptible lift. In some places the accumulation was nearly ¼ in. thick. Neither the machine operator nor the man in charge of the surfacing and edging paid any attention to this condition, and apparently it was not noticed by the inspector. Patches of this concrete would adhere to the surface of the steel forms, so that when they were shifted ahead and set in place they did not give a true surface, and fresh concrete would add to the obstruction.

Other Articles in This Issue of Interest to Contractors:

Rapid Concreting a Feature of Big Portsmouth Dry Dock — Page 494

Arrangement of Equipment in Engineer's Office — Page 502

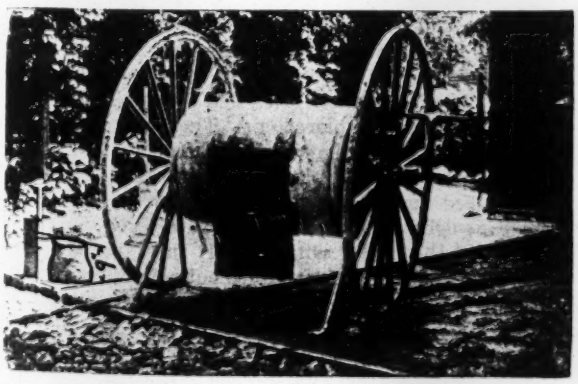
Dutch East Indies Offer Many Construction Opportunities — Page 497

Oil Drum Makes Portable Concrete Mixer

BY A. J. BECKWITH

Draftsman, United States Lighthouse Service, Milwaukee, Wis.

BY THE mounting of an old oil drum on a pair of concrete buggy wheels, the portable mixer shown in the accompanying view was devised on a recent job, and proved efficient and convenient in laying sidewalks and driveways. In operating it, materials are handled but once. The cart is filled at the gravel and stone pile, churned and pushed to the spot where the concrete is to be placed.



HAND-OPERATED CONCRETE MIXER

The outfit, with a capacity for a ½-bag batch, comprises an old oil drum, mounted on two old buggy wheels about 4 ft. in diameter, having 1-in. pipe axle and pipe fittings. The hinged door is made to close down tightly and is then clamped, and thereby any leakage of water is prevented. The interior of the drum is equipped with mixing blades properly arranged to throw the materials away from each end of the drum toward the center, as the drum revolves.

After the loading, the wheels are braced by the handle of the cart on one side and by blocks or a plank on the other, to prevent motion of the cart, for the drum is rotated by a hand crank. The latter, made up of pipes and fittings, has an extension pipe handle which slips freely into the outside crank handle, allowing it to be pushed in between the spokes of the wheel. Thereby the drum is held in any desired position, and the drum is allowed to revolve when the cart is in motion. If the haul is lengthy, mixing by pushing the cart will be found to work with surprising ease. As the wheels are free and work independently of each other, the cart may be turned around in a space no greater than its own width.

A slump test, as shown in the illustration, was made for one day's pouring on a 1:2 mix, using 9% water by volume, securing a 9-in. slump after the 12-in. cylinder was removed.

Simple Rack Files Many Prints

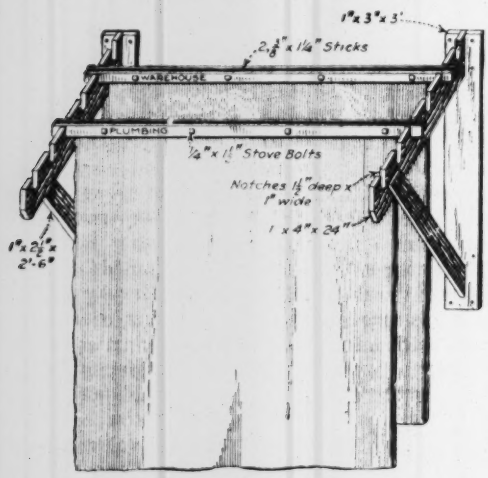
BY CHARLES P. RUMPF

Assistant Engineer, Snare & Triest Company, Philadelphia

ON A several million dollar contract, the following simple and concise method of filing and indexing plans, and keeping a record of their distribution, was adopted with success. Blueprints came from the drafting room to the plan file and distribution room, each plan having a descriptive title and a serial number. The plans were there divided into logical groups. On this contract, which happened to be a pier and warehouse job, 20 groupings were used, the following being characteristic: Pier substructure, warehouse, dredging, miscellaneous details, bills of material, plumbing, lighting.

Each group was filed on a separate binder, which was appropriately labeled and hung on a rack, as shown in the accompanying sketch. For every print a card was made out, giving the title of the plan and the group

under which it was filed. Such a card is reproduced herewith. These cards were filed in numerical order, and when a revised print was received the last date was noted on the card in the upper right-hand corner. The



SIMPLICITY AND UTILITY COMBINE IN THIS PLAN RACK

filing and indexing feature of the scheme directed a person looking for a plan to either the general group to which it pertained or to the number of the plan. In the first case he could look through the appropriate binder, and in the second case he would go to the card file and ascertain on which binder he would find the plan.

As noted above, the plans were not only filed but were distributed from this center, and the index cards further proved of much value as receipt cards. Anyone who has had to keep a field force supplied with con-

Print No. 423 Last Date 7-25-19 (7-19)

Binder:- Plumbing

Title:- Ship Water Supply

Pur. Dept. 7-25 G

Plumbers 7-25 Lem 8-7 Lem

Supt. 7-25 Mc. 8-17 Mc.

INDEX CARD IS ALSO RECEIPT FOR ISSUED PRINTS

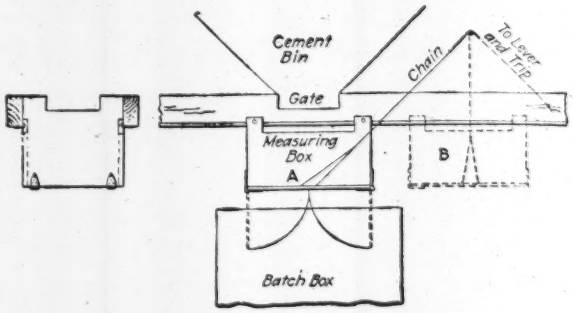
stantly revised plans will appreciate the value of a receipt card for outgoing plans. Upon receipt of either a new plan or a plan containing a revision, a request was made to the drafting room for enough additional prints to distribute to interested field and office parties. Date of delivery of the plan was noted in the lower left-hand corner of the card, and opposite this date the receiver was obliged to place his initials. The card was then filed.

The index card showed in complete form where a certain plan could be found, its last revised date, who had received copies of it, the date of the plan received, and the receipt therefor.

Measuring Box Reduces Clearance in Cement Bin

IN CHARGING batch boxes or car bodies with bulk cement from overhead bins, clearance is reduced by using the measuring-box arrangement illustrated by the accompanying diagram. Instead of measuring the cement in chutes integral with the bin and extending down 3 to 4 ft. from the bottom of the bin, separate measuring boxes, normally out of line of the locomotive or cars under the bin, are employed, and gates that are without chute extensions are placed in the bottoms of the bins.

As shown in the accompanying diagram, each box is hung so as to slide, barn-door fashion, between two beams; this allows it to be pulled to one side, B, to give headroom for the locomotive. The charging position, A, is shown by the full lines. In this position a chain to a lever and trip, arranged as the conditions make



MEASURING BOX ARRANGEMENT FOR OVERHEAD CEMENT BIN

most convenient, holds the double flap-door bottom closed; when the box has received the charge from the bin gate the lever is tripped and the weight of the cement swings the doors open, and the charge enters the batch box. With small clearances the dusting is insignificant in amount.

A measuring box of this type is used by the Mellon-Stuart-Nelson Co., Chicago, Ill., on concrete road work for Cook County, Illinois.

Gravel Deposits for Concrete Aggregate Explored by Suction Pumps

SUCTION pumps were used successfully for obtaining samples, at depths up to 20 ft., in exploring gravel beds for concrete aggregates at the flood-control dams of the Miami Conservancy District. Pits were first excavated to groundwater level, and then the pumps were installed for deeper explorations. These were simple suction pumps with 6-in. barrels 8 ft. long. An 8-in. casing was set upright on the pit bottom, and the pump barrel was inserted and let down into the gravel. A portable gas engine drew up the plunger by successive short jerks which filled the barrel with gravel; then the pump was withdrawn and the contents were put into 100-lb. sample bags, labeled according to their location in relation to surface and position.

As the gravel was pulled up into the pump barrel the 8-in. casing settled. By the addition of short lengths to the casing, depths of 20 ft. were reached.

NEWS OF THE WEEK

New York, September 11, 1919

American Water Works Body To Have New York Home

After many years of hoping and planning, the American Water Works Association will open headquarters in New York City, Oct. 15, on the first floor of 153 West 73rd Street, with John M. Diven, secretary, and Miss Charlotte S. Edgley, assistant secretary, in charge. Mr. Diven will devote his entire time to the association, having resigned as superintendent of water-works at Troy, N. Y., effective Oct. 1.

Secretary Diven will begin his full-time service as secretary of the association Oct. 15. Before becoming superintendent of the water-works at Troy, in February, 1912, Mr. Diven was superintendent of the Charleston, S. C., Light & Water Co., for seven years, and prior to that time he was superintendent of the Elmira Water, Light & Railroad Co., and the Elmira Water-Works Co., for many years.

Would Name Permanent Body To Fix Railroad Wages

The creation by Congress of a permanent Governmental commission to fix and adjust the wages of all railroad employees was urged in the Senate Sept. 4 by Senator Oscar W. Underwood, of Alabama, as an immediate and permanent solution of the railroad-wage controversy.

"There is but one way out, in my judgment," said Senator Underwood, "and that is to appoint a tribunal that will have the power to adjust these matters, and will have the time to consider and the opportunity to know the facts. Such a tribunal must not only have the power and be prepared to do what is right and just by the labor employed on the railroads, but must have authority and power to see that property is not confiscated by its decisions."

Wilmington, Del., Authorizes Port Improvements

Bonds to the amount of $3,000,000 have been authorized by the council of Wilmington, Del., for the development of the harbor. Immediate construction will be begun on a $400,000 produce wharf for the local market, and the remainder is to be devoted to general port improvement. A report was made to the city some years ago by John Meigs, consulting engineer, Philadelphia, in which an elaborate port scheme sufficient for many years was developed, and presumably the new work will start according to lines laid down in this report. The work will be in charge of the Board of Harbor Commissioners, Wilmington, Del.

Employment Bureaus

Engineering Societies' Employment Bureau of the four founder societies, conducted by Engineering Council Employment service, for members and for other professional men introduced by members. Especial attention for those released from Government service. Address, 29 W. 39th St., New York City.

American Association of Engineers, 29 S. La Salle St., Chicago. Service to members only, but Army or Navy Engineers in uniform who are eligible to certified membership may join without payment of entrance fees or dues while in uniform and for six months after discharge.

Engineers' Service Bureau, 57 Post St., San Francisco. Only applications by mail or wire will be considered.

Professional and Special Section, United States Employment Service, 469 Fifth Ave., New York City.

Reëmployment Committee of New York City for Soldiers, Sailors and Marines, 505 Pearl St.

To Support Jones-Reavis Bill

The American Association of Engineers has issued a request to each of its members to write to his Congressman requesting his support of the Jones-Reavis bill providing for a national department of Public Works. Instructions are being issued to each chapter and club, containing means of stimulating local interest in this bill and of obtaining the support of the voters in each community.

Oregon Board for Examination of Engineers Organized

In accordance with a law passed by the last session of the Oregon state legislature, the Oregon State Board of Engineering Examiners has been organized, with O. Laurgaard, city engineer of Portland, as president. The other officers are F. D. Weber, electrical engineer with the Oregon Insurance and Rating Bureau, vice-president; and A. B. Carter, civil and mining engineer, secretary. The board has established headquarters in Portland for receiving applications for registration of all professional engineers practicing in the state.

The bill, which became effective July 1, requires, for those properly qualified, registration without examination; or registration and examination of all professional engineers—mining, civil, mechanical, hydraulic or electrical—practicing in the state.

States May Get Army's Road-Building Plant

House Committee Begins Hearings on Transfer of Surplus War Department Property

A bill providing that motor vehicles and motor equipment which will be declared surplus by the War Department may be transferred to the Postoffice Department and the Department of Agriculture, for use in the building and maintenance of roads, was last week introduced in the House by Representative Julius Kahn of California. This bill was introduced with the intention of superseding the provision to the same effect in the Federal road-aid act and the Postoffice act and of obviating the difficulties which these provisions encountered in the actual transfer of surplus material from the War Department to the other Government departments.

By a ruling of the Judge Advocate General of the Army, it was decided that such transfers could not be made without transfer of funds, and the new bill specifically states that surplus motor vehicles and motor equipment may be transferred without a transfer of funds. The new bill, however, still leaves the transfer of any material to the discretion of the Secretary of War. The ruling of the Judge Advocate General explains why the Department of Agriculture, particularly the Forest Service and the Bureau of Public Roads and Rural Engineering, had not received the equipment for which they had petitioned. Despite this ruling, however, it was learned that the Forest Service this week was notified that some 230 sets of harness and a number of motorcycles, forges, and 13 concrete mixers were consigned to be delivered to the various districts of that department.

The House Committee on Military Affairs Sept. 9 opened hearings to thresh out the entire matter of the distribution of surplus War Department equipment for use in connection with road construction. The position of the War Department, as set forth by Guy Hutchinson, assistant director of sales, is that the expressions of Congress are conflicting, and that pending further Congressional action the War Department is making no transfers of materials. The department, he told the committee, is more than anxious to clear up its surplus property, and urges that Congress advise specifically what is to be transferred and to make clear the conditions of such transfers.

Chairman Kahn, of the committee, indicated that he is displeased because the Department of Agriculture has

requisitioned vast quantities of materials which are used only incidentally in the construction of roads. He mentioned under that head office supplies, mules, horses, forage and mess equipment.

At this writing no opportunity has been offered for the presentation to the committee of the attitude of the Bureau of Roads. Thomas H. MacDonald was on the stand for a short time, but simply to reply to questions of members of the committee concerning the manner in which the equipment is being distributed to the states. Members of the committee, however, expressed the opinion that the War Department had been obstructive in its general relation with the Bureau of Public Roads and had retarded road work thereby in every state. As a result of the technical delays and hair-splitting tactics, state highway commissions are in a condition of uncertainty, and much work has been held up which could have been done while there were plenty of cars for transporting materials.

War Department's Interpretation

The War Department's interpretation, according to Mr. Hutchinson, placed road rollers, concrete mixers, trucks, passenger cars, rock crushers and similar equipment for direct use in road building within the intent of Congress in its original legislation. There seems to be some doubt, however, as to requests for the delivery for road work of such materials as locomotives and cars, lumber, cement, hammers, blankets, draft animals, office furniture and supplies.

It was also pointed out that the uncertainty as to whether or not the trucks and other road-building equipment are to be sold to the public is producing an unsettled effect on industries. Members of the committee, however, expressed the belief that there is no reason for any one to expect that the actual road-building equipment will not be turned over to the states. They regard that as being too obvious to afford opportunity for any important unsteadying of the machinery or truck markets. It is expected that the hearings will continue several days.

The hearing, it is believed, was hastened by the introduction, Sept. 6, of a bill by Senator Hoke Smith, of Georgia. That bill, which has the approval of the Bureau of Public Roads, provides that nothing contained in Sec. 5, of the last sundry civil act, is to be construed as in any way affecting the transfer, free of charge, of motor-propelled vehicles and motor equipment and other war material, equipment and supplies, not needed by the War Department, as provided in Sec. 7 of the Postoffice appropriation act. Sec. 5 of the sundry civil act specifies that any executive department may buy surplus motor and other equipment, but it provides that no transfer of such equipment is to be made free of charge unless specific authorization is given by Congress. The War Department interprets that section as applying to the transfer of surplus equipment to the states through the agency of the Department of Agriculture. The Solicitor of the Department of Agriculture does not agree with the War Department's interpretation. He holds that the transfer is to the states and not to the Department of Agriculture, which simply acts as the agent for the states.

The Smith bill goes on to specify that it is the intent of Congress that Sec. 7 of the Postoffice appropriation act is meant to apply to all equipment and materials which can be used in the construction and maintenance of roads, and that the law prohibiting the expenditure of appropriations by any of the executive departments for the maintenance, repair or operation of passenger-carrying vehicles, in the absence of specified statutory authority, is not to apply to the vehicles transferred for road work. The Smith bill also specifies that the Secretary of War is authorized, in his discretion, to transfer, free of charge, to the Postoffice Department, such motor vehicles as may be found to be surplus.

Incidentally, the truck manufacturers are very much in favor of having all surplus War Department trucks turned over to the state highway commissions. They never before have had an opportunity, it is pointed out, to distribute 20,000 trucks throughout the 3000 counties of the United States. The truck manufacturers are confident that the general use of trucks which this distribution will bring about will make clear the superiority of motor equipment and will result in a large number of purchases from a class of customers who otherwise would have continued to use animal traction for many years.

Banquet to Hoover Will Be Held September 16

The banquet arranged by engineers in honor of Herbert C. Hover, upon his arrival in this country, as noted in *Engineering News-Record* of Sept. 4, 1919, p. 485, will be held at the Waldorf-Astoria Hotel in New York City Sept. 16. The arrangements have been made by the American Institute of Mining and Metallurgical Engineers through a committee headed by W. L. Saunders.

Contractors Refuse to Bid Save on Cost-Plus Basis

Work on the proposed 25,000,000-gal. reservoir to be constructed in connection with the water system at Walla Walla, Wash., will be postponed until next spring, owing to the impossibility of getting contractors to submit bids except on the cost-plus basis.

Montreal Aqueduct Arbitration Favorable to City

Contractor Must Pay Damages for Break in Water-Supply Conduit and Contract Delay

An award favorable to the City of Montreal has been made by the arbitrators appointed to consider the claims between the Cook Construction Co. and the city, growing out of the contract for the enlargement of the Montreal aqueduct, and also out of the break in the water-supply conduit. The arbitrators were Aimé Geoffrion, K. C., John M. R. Fairbairn, chief engineer of the Canadian Pacific Ry., and W. F. Tye, consulting engineer, all of Montreal.

In July, 1913, the city awarded to the company a contract for the enlargement of the Montreal aqueduct which amounted to about $2,323,000 and was subsequently increased by various additions to about $2,950,000. Work on this contract for the aqueduct enlargement was carried on intermittently from the autumn of 1913 to the autumn of 1917, and was attended with considerable controversy between the contractor and the city. On Dec. 26, 1917, both of the parties agreed to cancel the contract and submit their respective claims to the arbitrators for settlement. The value of the work completed at this time amounted to about 46% of the original tender price.

Break in Aqueduct

On Dec. 25, 1913, a break occurred in the water-supply conduit situated on the north side of and close to the aqueduct (see *Engineering News* of Jan. 1, 1914, p. 54, and *Engineering Record* of Mar. 7, 1914, p. 274 and p. 277). As this conduit was then the sole source of supply, the city was deprived of water until temporary repairs were made and service was restored on Jan. 2, 1914. The city maintained that the break was due to the failure of the contractor to adopt needed precautions in carrying on excavation work adjacent to the conduit, and originally claimed a total of $412,000, covering not only the amounts expended by the city at the time of the break, but also the cost of certain protection work done to safeguard the conduit, and the cost of installing a water-supply connection with the Lachine canal for emergency service. A majority of the arbitrators (Mr. Tye dissenting) held that the contractor was responsible for the break and awarded the city $82,000 damages, covering the amount expended by the city at the time of the break.

The claims of the Cook Construction Co. against the city for delays, damages, extra work, etc., originally amounted to $1,922,000, plus interest, and were subsequently reduced to $1,775,000, plus $75,000 interest up to Dec. 26, 1917. The three arbitrators awarded the contractor about $432,000, plus certain interest amounting to about $17,000 up to Dec. 26, 1917. Of the $432,000, about

$216,000 is awarded for damages on account of delays by the city for which the contractor orginially claimed $673,000.

The city also submitted claims against the contractor, principally for noncompletion of part of the work and for delays, amounting to about $259,000. On these claims the arbitrators awarded about $48,000 which, together with the award on the conduit break, makes a total of about $130,000 in favor of the city. Deducting this sum from the award of $432,000 to the contractor leaves a net payment of about $300,000, plus certain interest charges, to be paid by the city to the contractor.

Complete Valuation of Washington, D. C., Street Railways

The valuation, for purposes of rate-making, of the properties of the Capital Traction Co. and the Washington Railway & Electric Co. of Washington, D. C., which was begun in May, 1914, has been completed by the Public Utilities Commission of Washington.

The findings of the commission declare a fair total value of the Capital Traction Co. as of June 30, 1919, to be $14,270,495, or approximately an increase of $1,000,000 over the value set by the commission for the company as of July 1, 1914. The company's claim for reproduction value, including expenditures as of June 30, 1919, was $25,951,679; while its historical-value estimate, including expenditures, as of the same date, is $19,418,298.

A fair total value for the Washington Railway & Electric Co. was fixed by the commission at $16,106,368 as of June 30, 1919, which allowed an increase of valuation of $1,500,000 since July 1, 1919. This company, estimating up to July 1, 1916, submitted claims of $30,778,083 for historical value, and $29,656,382 for reproductive value.

One of the commissioners rendered a dissenting vote and in view of this fact it is expected that an appeal will be taken by the companies. An appeal might delay the establishment of the valuation for several years, as an appeal taken by a subsidiary of the Washington Railway & Electric Co. against a valuation set by the commission in May, 1917, is still pending in the courts.

Sacramento to Have Municipal Filter Plant

The City of Sacramento, Calif., is to install a mechanical filter plant. Its nominal capacity will be 30,000,000 gal. per day, the source of supply being the Sacramento River.

Charles Gilman Hyde, professor of sanitary engineering at the University of California, is preparing the plans for the plant. The people of Sacramento authorized a $1,800,000 bond issue at the June, 1919, election, and it is expected that the filtration plant will be in operation early in 1921.

Program for New England Water Works Convention

Preliminary notice regarding the 38th annual convention of the New England Water Works Association, which will take place at Albany, N. Y., Sept. 30-Oct. 3, has just been issued by Secretary Willard Kent. In addition to a number of important committee reports, there will be presented a program of 15 or more technical papers, arrangements for which have been completed by Charles W. Sherman.

Norman J. Howard, bacteriologist in charge, will discuss the operation of the new drifting sand filter system at Toronto. The Schoharie development of New York City's water-supply will form the subject of an address by J. Waldo Smith, chief engineer, Board of Water Supply. Col. Francis F. Longley, of the firm of Hazen, Whipple & Fuller, consulting engineers, and until recently officer in charge of the water-supply section of the Division of Military Engineering and Engineer Supplies, under the Chief Engineer, A. E. F., will explain how water was supplied to the American Armies in France. For his work with the A. E. F., Colonel Longley received the Distinguished Service Medal. Another paper will be devoted to the 10,000,000-gal. covered reservoir at Dayton, Ohio; the authors are Leonard Metcalf and William T. Barnes, of the firm of Metcalf & Eddy, consulting engineers, Boston.

Two papers on pumping engines are scheduled. The first is by Creed W. Fulton of the Gould's Manufacturing Co., and the second by D. A. Decrow of the Worthington Pump & Machinery Corporation.

A program of entertainment has been arranged by the Water-works Manufacturers' Association, and a large participation is expected in the exhibition of water-works equipment and supplies.

The headquarters for the convention will be in the Hotel Ten Eyck.

Safety Council To Hold Congress in Cleveland Next Month

The eighth annual Safety Congress will be held at the Hotel Statler, Cleveland, Oct. 1-4. In addition to the general sessions, at which such subjects as employees' representation, Americanization, health, and safety education, will be discussed, there will be additional features in the form of round-table and sectional meetings. Among the latter are scheduled sessions devoted to construction, cement, steam railroads and public utilities.

Among the papers to be presented before the construction section are the following: "How the Small Contractor Can Reduce Accidents," by George A. Rutherford, of the George A. Rutherford Co., Cleveland, Ohio; "Protecting the Public Against Accident on New Buildings," by C. M. Talbert, director of the Department of Streets and Sewers, St. Louis, Mo.; "Plant and Machinery Layout," by Kenneth Moller, of Lockwood, Greene & Co., Boston, Mass.; "Safety in Steel Erection," by Col. E. A. Gibbs, of the McClintic-Marshall Co., Pittsburgh, Penn.; "Results of Safety Work in Shipbuilding," by Harry A. Schultz, of the American Steel & Wire Co., Cleveland, Ohio; "Coöperating on Safety," by F. J. Dresser, of the Austin Co., Cleveland, Ohio.

Missouri Valley Road Builders' Association Organized

At a meeting of contractors, representatives of material companies, and county, state, municipal and Federal engineers, held in Kansas City Sept. 2, it was decided to organize the Missouri Valley Road Builders' Association. The purpose of the organization is to establish closer coöperation and better understanding among contractors, engineers, material companies and highway officials in general.

The officers elected were as follows: Chairman, M. W. Watson, state highway engineer of Kansas; secretary-treasurer, M. R. Amerman, contractor, Salina, Kan., and an executive committee composed of the two above-named officers, with S. A. Fones of the Independent Gravel Co., Joplin, Mo.; A. W. Graham, state highway engineer of Missouri, and R. E. O'Brien of the Cook & O'Brien Construction Company.

Turkey Creek Sewer Contract for Canadian Contractor

The contract for the construction of the Turkey Creek sewer, Kansas City, Mo., amounting to about $2,500,000, has been awarded to Thomas Kelley & Sons, Ltd., Winnipeg, Canada, the only bidder. The work involves among other items, 1750 ft. of 17 x 18 ft. double-box reinforced-concrete sewer, and two pumping stations. Work will not be paid for until completed, and then with four years' special tax bills, bearing 7 per cent. interest, payable one-fourth each year. These tax bills are practically bonds against the benefited property.

The property to be benefited by the construction of the Turkey Creek sewer includes approximately 5000 acres. The principal item in the construction is a main reinforced-concrete sewer approximately 1¼ miles long.

Utah Counties Unite in Water-Storage Study

The Utah Water Storage Association has engaged A. F. Parker, consulting engineer, Ogden, Utah, to investigate the storage possibilities in the eight counties which are adjacent to Salt Lake and which contribute to a fund for the purpose. Offices have been

opened in the state capitol, and an invitation has been extended to all counties to join the association. The executive committee includes George F. McGonagle, state engineer, and J. L. Lytel, project manager of the United States Reclamation Service at Provo. Two parties are now in the field, but Mr. Parker states that men of the experience needed are hard to obtain.

Civil Service Examinations

New York State. Bridge designer, office of Transit Construction Commissioner, $1500 to $2100, Sept. 27. Apply to Civil Service Commission at Albany for application forms, before Sept. 15.

New York State. Junior assistant engineer, State Engineer and Highway Department, $1200 to $1440, Sept. 27. Apply to Civil Service Commission at Albany for application forms, before Sept. 15.

New York State. Junior engineer, Transit Construction Commission, New York City, $1200 to $1500, Sept. 27. Apply to Civil Service Commission at Albany for application forms, before Sept. 15.

New York State. Sanitary engineering inspector, State Department of Health, $1320, Sept. 27. Apply to Civil Service Commission at Albany for application forms, before Sept. 15.

United States

For United States civil service examinations, listed below, apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the commission, for form 1312.

Chief metallurgist, $4500 to $5000 per year; assistant chief metallurgist, $3600 to $4500 per year, Ordnance Department. Applications must be filed before Sept. 16.

Computer, Ordnance, Navy Yard, Washington, D. C., $7.20 to $12 per diem, Sept. 17. File applications in time to arrange for examination at place selected by applicant.

Junior highway bridge engineer, Office of Public Roads and Rural Engineering, Department of Agriculture, $1200 to $1600 per year, Sept. 17. File applications with commission at Washington in time to arrange for examination at place selected by applicant.

Assistant examiner, Patent Office, Washington, D. C., $1500 to $1740 per year, Sept. 17 to 19 and Nov. 19 to 21. File applications in time to arrange for examination at place selected by applicant.

Engineer, $3000 per year; assistant engineer, $1800 to $2880 per year; junior engineer, $1200 to $1740 per year; engineering draftsman, $1200 to $3000 per year, Reclamation Service. Applications will be received until further notice.

ENGINEERING SOCIETIES

Calendar

Annual Meeting

NEW ENGLAND WATER WORKS ASSOCIATION; Tremont Temple, Boston, Sept. 30, Oct. 1-3, Albany, N. Y.

NATIONAL SAFETY COUNCIL, 168 Michigan Ave., Chicago; Oct. 1-4, Cleveland.

AMERICAN SOCIETY OF NAVAL ENGINEERS; Secretary, Lieut. Com. F. W. Sterling, U.S.N., Navy Department, Washington, D. C.; Oct. 7, Washington.

AMERICAN PUBLIC HEALTH ASSOCIATION: 169 Massachusetts Ave., Boston; Oct. 27-30, New Orleans.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS; 304 E. Walnut St., Bloomington, Ill.; Nov. 11-14, New Orleans.

SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS; 29 W. 39th St., New York City; Nov. 13, New York City.

The Cleveland Engineering Society and members of the four national engineering societies held a combination meeting Sept. 9. It was the opening meeting of the Cleveland Society, and the entire day was devoted to matters of interest to the engineer. Notable among the discussions were those of engineering problems of Cleveland's rapid-transit development, and hydro-electric developments in Italy and South America.

The Rochester Engineering Society, at its meeting Sept. 12, will listen to a discussion on building Army cantonments, and other military construction problems, by John F. Skinner, formerly a captain in the Construction Division. A representative of Engineering Council will address the society at its October meeting, and at its November meeting Dr. E. B. Rosa, chief physicist, Bureau of Standards, Washington, D. C., will be the speaker.

The Allied Engineering Association, Charleston, S. C., will hold its first meeting of the 1919-1920 season Sept. 15. The principal speaker will be Lieut. Col. Herbert A. Dargue, who will read a paper on aviation. Some phases of the patent situation will be covered by F. L. Lebby.

Mining engineers in and around Miami, Ariz., recently formed a temporary organization to apply for a charter in the American Association of Engineers. Approximately 100 engineers residing in the district were present, and enrolled as charter members of the new organization.

The Cleveland Chapter of the American Association of Engineers, at its regular meeting Sept. 4, listened to an address by F. N. Thatcher, district promotional secretary of the Pittsburgh district. The chapter membership committee has initiated a plan designed to add a thousand new members to the chapter before Jan. 1, 1920. A committee was appointed to seek for the employment of a full-time, paid secretary for the State of Ohio. More than 10 per cent. of the entire national membership is found in the four chapters and five clubs in that state.

PERSONAL NOTES

A. B. HARGIS, for the past two years in charge of the office at Camp McClelian of MORRIS KNOWLES, INC., supervising engineers, recently completed his work there and returned to the home office in Pittsburgh.

HARRY HODGMAN, for the past six years connected with Missouri River improvements as United States Assistant Engineer, with offices at Jefferson City, Mo., has been transferred to the Detroit River district. He will have charge, under the direction of Col. E. M. Markham, Corps of Engineers, U. S. A., of the widening of the Livingstone channel.

COL. E. H. ABADIE, U. S. A., recently supervising constructor, construction division, Quartermaster Corps, has been appointed comptroller of the Division of Operations, United States Shipping Board, according to a recent announcement made by the board. Colonel Abadie was commissioned a major of engineers in June, 1917, but later was transferred to the Quartermaster Corps, having under supervision the construction of Camps Funston, Dodge and Lee, as well as many small military installations.

CAPT. HOWARD J. COLE, upon his discharge from the service, has resumed his position as general superintendent for the P. J. Carlin Construction Co. He is in charge of the construction of the new prison buildings at Ossining, N. Y.

C. C. VAN ARNSDOLL and FRED OEHLER, of Clarkston, Wash., and E. M. BOOTH, of Lewiston, Idaho, have formed an engineering partnership to specialize in highway construction work. Mr. Booth was formerly state highway engineer of Idaho.

LIEUT. WALDO H. CHASE, U. S. A., recently discharged from service with the 115th Engineers after a year overseas, has resumed his position as engineer with the northern division of the state highway department, California.

W. L. DUGAN, Seattle, contractor, who recently returned from France with the 18th Engineers, has been discharged, and will reënter contracting work in Seattle.

CAPT. O. E. BROWNELL, Engineers, U. S. A., who recently received

his discharge from the service, has become associated with MORELL & NICHOLS, landscape architects and engineers, Minneapolis, Minn. He will take charge of civil and municipal work. Before entering the Army Captain Brownell was chief assistant city engineer of Duluth.

CAPT. E. D. HENDRICKS, Engineers, U. S. A., recently discharged from the service, has been appointed division engineer of the eastern division, New York State, with headquarters in Albany. Work on all canals and terminals east of Utica and including New York City will be under Captain Hendricks' supervision. Captain Hendricks was cited by General Pershing for distinguished service while he was with the 303rd Engineers in France.

JAMES H. MANNING has been appointed assistant engineering manager for STONE & WEBSTER. He joined the staff of Stone & Webster in 1910, and served as superintendent of construction on the Franklin, Verdi and White Salmon hydro-electric developments, besides preparing various engineering reports. He was later made head of the hydraulic division. In 1917 he became chief engineer of the American International Shipbuilding Corporation. Early in 1919 Mr. Manning was made consulting hydraulic engineer for Stone & Webster, and recently was appointed assistant engineering manager.

ELBERT G. ALLEN has been appointed advisory engineer for STONE & WEBSTER. Since his graduation from the Massachusetts Institute of Technology in 1901 Mr. Allen has been in the continuous employ of the company, having been engaged for the most part on work at Boston and in the Puget Sound district. In 1918 he was made assistant engineering manager.

CRESLEIGH GRAY has been appointed engineer in charge of the recently organized bureau of contracts, one of the five subdivisions of the division of construction, Indiana State Highway Commission. Mr. Gray is a graduate of Rose Polytechnic Institute and has been connected with the State Highway Commission since its organization several months ago. KARL EISENHARDT has been appointed assistant engineer of the Bureau of Contracts.

M. A. LONG, assistant to the chief engineer and architect of the Baltimore & Ohio R. R., for many years, has resigned and has entered the contracting engineering business. Under the name of the M. A. LONG Co. he has opened an office at 1523 Munsey Bldg., Baltimore, Md. During Mr. Long's association with the Baltimore & Ohio he handled a number of important pieces of building construction; among them were the large terminal warehouses of the railroad in Cincinnati, Baltimore, Pittsburgh and New York. He also superintended the construction of the Baltimore & Ohio general office building, Baltimore.

CAPT. JOHN L. BACON, U. S. A., formerly with the 602d Engineers in France, has received his discharge and has returned to San Diego, Calif. He has not announced his plans for the future.

COL. EARL I. BROWN, Engineer Corps, U. S. A., who returned recently from service overseas, has been assigned to Cincinnati Engineering District No. 1, and will be in charge of improvements along the Ohio River in this district. He succeeds ASSISTANT ENGINEER R. R. JONES, in charge of the Cincinnati office.

ARTHUR C. MARBLE, who has served the City of Lawrence, Mass., continuously since 1875, has resigned as city engineer, his resignation to become effective Sept. 15. Mr. Marble retires to private life. ROBERT W. PRIESTMAN, first assistant to Mr. Marble for a number of years, has been named city engineer.

CAPT. WILLIAM E. STANLEY, Engineers, U. S. A., who recently returned from 20 months' service in France, has received his discharge from the service and has accepted a position with PEARCE & GREELEY, consulting sanitary and hydraulic engineers, Chicago. Mr. Stanley will be resident engineer on the construction of a sewer system for South Charleston, W. Va. Before entering the service Captain Stanley was instructor in hydraulics at Purdue University.

E. ST. LAURENT, assistant harbor engineer of Port Arthur, Ont., has been appointed district harbor engineer, with headquarters at Fort William, in place of H. B. R. CRAIG.

MAJ. CHARLES GILMAN HYDE, U. S. A., until recently on duty at the office of the Surgeon General in Washington, D. C., has been discharged from the service and has resumed his position at the University of California as professor of sanitary engineering. He has been retained by the City of Sacramento, Calif., as consulting engineer in the construction of a water-filtration and pumping plant, for which bonds to the amount of $1,800,000 were voted in June, 1919.

CEDRIC B. SMITH has been appointed editor of *The Monad*, the official organ of the American Association of Engineers. Mr. Smith is a graduate in both arts and civil engineering from the University of Minnesota. His engineering experience has been with the Oregon Trunk Ry., the Great Northern Ry., the Chicago Great Western R.R., and the Pennsylvania Lines West of Pittsburgh. During the war he served as an officer with the 74th Artillery in the American Expeditionary Forces in France.

U. S. MARSHALL, senior highway engineer in the United States Bureau of Public Roads, until recently in charge of the Missoula branch office of the bureau, has resigned to accept the position of assistant chief engineer with the Montana State Highway Commission, at Helena.

E. C. GWILLIM has received the appointment as city engineer of Sheridan, Wyo., to fill the vacancy created by the resignation of H. M. HUNTINGTON. Mr. Gwillim was recently discharged from military service.

GEORGE B. MASSEY, who was engaged in mine-laying work in the North Sea during the war, has left the United States Navy and has resumed his work as consulting engineer on excavation, with offices in the People's Gas Bldg., Chicago.

H. A. BOWMAN, chief engineer of the Manitoba Department of Public Works, has been appointed head of a new branch of the department to be known as the reclamation branch, which will conduct the work of drainage in the province. It is estimated that there are 7,000,000 acres of swamp land in Manitoba to be drained under the supervision of the new reclamation branch.

GEORGE H. BRYANT, city engineer of Brockville, Ont., for the past seven years, is resigning that position to assume direction of the operations of the Brockville Highway Construction Co., which has secured the contract for the Brockville-Prescott section of the provincial highway.

T. M. KEENE, senior highway engineer in the United States Bureau of Public Roads, has been transferred from the Portland office to take charge of the Missoula, Mont., office of the same bureau to replace U. S. Marshall, resigned, as noted elsewhere in these columns.

FRED GEHBAUER, of the Chicago Pneumatic Tool Co., has been appointed special Navy Yard representative, with headquarters at the Philadelphia offices of the company.

CAPTS. JOHN MAHER, GEORGE B. FARLOW, JOSEPH M. LEWIS, PAUL W. ELMORE, and LIEUTS W. B. MAURER, J. W. PURDY and J. D. STEMM, U. S. A., have been discharged from military service and have reported for duty as assistant engineers, Baltimore & Ohio R.R., Western Lines, at Cincinnati, Ohio.

OBITUARY

THOMAS L. MORTON, principal assistant engineer of the Atlantic Coast Line R.R., died at the hospital at the University of Virginia, Charlottesville, Va., Aug. 27, 1919, after an illness of about three months. Mr. Morton was 65 years of age. He was born at Petersburg, Va., and received his education at McGate's School, Richmond, Va., and at Oxford University, England. In 1883 he entered the service of the Plant sys-

tem of railways as engineer in charge of location and construction of the line from Tampa, Fla., to Kissimmee, Fla. When the Plant system was purchased by the Atlantic Coast Line Railroad Co., Mr. Morton remained with the Coast Line, and after several years' service was promoted to the position which he held at the time of his death.

OTTO A. RUEMELIN, for the past 12 years works manager of Pawling & Harnischfeger, and the company's second vice-president, died at Milwaukee, Wis., Sept. 1. Mr. Ruemelin had been associated with the company during the past thirty years, entering its service as an apprentice.

A. C. MCKENZIE, of Winnipeg, vice-president of the Northern Construction Co., died recently of heart disease while on a trip of inspection to the power plant on the Winnipeg River that his company is building. Mr. McKenzie was 56 years of age. Besides his connection with the Northern Construction Co. he was president of the Winnipeg Aqueduct Company.

EBEN BRIGGS THOMAS, for 15 years president of the Lehigh Valley R.R., and more recently chairman of the executive committee of the board of directors, died at his home in Morristown, N. J., Sept. 4. He was 77 years of age. Prior to his identification with the Lehigh Valley R.R., Mr. Thomas was president of the Erie R.R. Other executive positions he held at various times were those of general manager of the Cleveland, Columbus, Cincinnati & Indianapolis Ry., second vice-president and general manager of the Richmond & Danville, Georgia & Pacific road; first vice-president of the New York, Lake Erie & Western, and president of the Chicago & Erie, until its reorganization as the Erie R.R., when he became its president.

Highway Industries Association Aids Road Promotion

Coöperation in highway-improvement campaigns through an editorial and news publicity service, under J. W. Brooks, director of the editorial department of the Highway Industries Association, is offered to all those interested in such promotion. The service mentioned also aims to assist in arranging expense budgets for road campaigns along the most effective lines, thus minimizing waste of funds through scattered and indirect publicity, and to suggest the best method of raising the funds.

Details of the coöperative plan are set forth in a circular recently issued by the association. It is stated that, inasmuch as the association represents all the factors interested in the use of the public highways, it is in a position to render free and impartial service which could not be given by a single interest.

The means to be used in promotion include press service, public speaking, motion-picture production, and suggestions for printed circular matter. Full particulars may be obtained by communicating with H. G. Shirley, secretary of the association, Washington, D. C.

BUSINESS NOTES

THE STEEL CONSTRUCTION CO., structural engineers and erectors, has discontinued its Salt Lake office and will make its headquarters in Denver, Colo.

THE AMERICAN STEEL EXPORT CO. has appointed A. A. Schneider, formerly with the raw materials department of the Midvale Steel & Ordnance Co. and the Cambria Steel Co., as manager of its newly created raw materials division. Mr. Schneider recently returned from military service. In his new position he will handle imports, exports and domestic sales of pig iron, manganese, chrome and low-phosphorus iron ores, ferro-alloys, coal and coke.

WILLIAM H. BAKER has resigned his position with the Atlas Portland Cement Co. and has joined the staff of the Hardinge Conical Mill Co., 120 Broadway, New York, as vice-president. Mr. Baker has been connected with the operation of cement plants for many years, and has recently been interested in adapting conical ball grinding machinery for grinding cement clinker. He will have executive supervision of the promotion of the machinery of the company for cement grinding.

THE LAKEWOOD ENGINEERING CO., Cleveland, Ohio, has appointed Harry W. Benkart as its representative in Buffalo, N. Y., with offices in the Ellicott Square Bldg. Mr. Benkart was previously associated with the Dravo Construction Co. as superintendent, and has had about ten years' experience in the construction field.

THE CHAIN BELT CO., Milwaukee, Wis., has appointed Russell E. Dean to take charge of its mixer business in the territory from Boston to Norfolk, Va. His office will be at 50 Church St., New York City, from which location he will coöperate with the various representatives of the company in his territory.

THE CHICAGO MICA CO. has recently appointed L. T. Frederick as consulting engineer and production manager. Mr. Frederick was formerly process engineer of the Westinghouse Electric & Manufacturing Co., Pittsburgh.

THE TEXAS CREOSOTE MANUFACTURING CO. has been organized at Forth Worth, Tex., with a capital of $500,000, to manufacture creosote and other coal-tar products together with roofing and roofing materials. The present capacity of the company is 6000 gallons of creosote per hour, and it is planned to increase this ouput greatly. W. M. Babcock, president of the Home Oil & Refining Co., is president of the new organization and Dr. E. Morrill is managing director.

THE OSGOOD CO., Marion, Ohio, manufacturer of steam shovels, dredges and excavators, has opened a branch sales office in the Land Title Bldg., Philadelphia, Penn. W. W. Houston is local sales manager.

THE INTER-STATE MACHINERY CORPORATION, with offices in Philadelphia, Penn., has been formed to succeed the Ralph R. Lewis Co. of that city. The management and offices have been retained.

TRADE PUBLICATIONS

The following companies have issued trade publications:

THE QUANTITY SURVEY CO., INC., New York City; bulletin explaining the features of its method of analyzing contracts and specifications, and preparing lists of quantities of material for the use of prospective bidders.

THE CLARK EQUIPMENT CO., 1415 Railway Exchange, Chicago; booklet, 7 x 10¼ in., 31 pages, illustrated; describes the method used by the company in promoting *esprit de corps* among its employees; the title is "Putting Mettle into Metal." It also shows drills made by the company.

THE INTERNATIONAL NICKEL CO., 43 Exchange Place, New York; booklet, 4 x 9¼ in., 22 pages, illustrated; gives information regarding nickel and its products.

THE GUARANTY TRUST CO. of New York; booklet, 4½ x 7 in., eight pages; subject, "Federal Stamp Taxes on Drafts, Checks and Promissory Notes."

THE J. EDWARD OGDEN CO., INC., New York; catalog; 8 x 11 in., 36 pages, illustrated; describes turnover doors for piers, warehouses, garages, shops and industrial buildings.

THE DE LAVAL SEPARATOR CO., 165 Broadway, New York City; four bulletins, 8 x 11 in., with pages as follows: No. 100, 24; No. 101, 16; No. 102, 20; No. 103, 12; all illustrated; the bulletins describe, respectively, purifying and reclaiming oils, reclaiming cutting and hardening oils, reclaiming crank-case oils, and purifying and reclaiming oils used for marine purposes.

THE TRUSCON STEEL CO., Detroit, Mich.; catalog, 8½ x 11 in., 23 pages, illustrated; covers sections and uses of structural pressed steel for floors, roofs, walls and partitions.